UNITED STATES ATOMIC ENERGY COMMISSION

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in the Fields of

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BIOLOGY AND MEDICINE

4640
[Washington State Coll.]
RATE OF MOVEMENT OF IONS INTO AND THROUGH PARENCHYMA TISSUE AS AFFECTED BY RATE OF WATER UPTAKE; APRIL 1–JUNE 30, 1949. N. Higinbotham. [nd] 2p. (AECU-1400; WSC-1)

Progress is reported on preliminary work including a literature survey, ordering of materials, and calibration of instruments. No technical information is included.

4641
New York Univ., Coll. of Medicine
INTRACELLULAR CHLORIDE IN MAN. Norman Deane, Morris Ziff, and Homer W. Smith. [nd] 11p. (AECU-1531)

Intracellular chloride has been determined from simultaneous studies of body water distribution (total body water and extracellular fluid) and total body chloride as measured by the bromide dilution method. Intracellular chloride averages 29.9 milliequiv/liter (range 26.7 to 34.1) of cell water, 12.9 milliequiv/kg (range 10.6 to 14.6) of cell mass and 20.9 milliequiv/kg (range 15.1 to 30.2) of body solid. (auth)

4642
Oak Ridge National Lab.
PREPARATION OF BIOLOGICAL SAMPLES AND CORRECTION OF DATA. Venus I. Knobf. Aug. 3, 1951. 24p. (ORNL-1048)

Numerous problems were encountered in the laboratory studies of radioactivity of fish taken from the Clinch River and White Oak Lake. Acid digesting and ashing of flesh of fish taken from White Oak Lake resulted in a small loss of activity but this treatment of bone and scale from the same fish produced no detectable loss. Ashing of samples reduced self-absorption and, thus usually permitted a more accurate counting measurement. Nitric acid digestion without the addition of sulfuric acid appeared preferable since the samples treated with both acids had higher ashed weights and were also more hygroscopic. The internal organs and gills of fish from White Oak Lake often contained volatile radioactive isotopes. The inconsistency of results from Al absorption and decay studies indicated the presence of a diversity of short-lived high-energy isotopes. (auth)

4643
RUTIN THERAPY IN DIFFUSE CAPILLARY BLEEDING; INEFFECTIVENESS WHEN FRAGILITY TESTS ARE NORMAL. W. H. Glass. Am. J. Med. Sci. 220, 409(1950) Oct.

An abstract of this article appears in Circulation 3, 954 (1951) June and is reproduced here in its entirety.

Numerous studies on the clinical effectiveness of rutin in the management of bleeding states has led to considerable doubt in regard to its therapeutic value for these conditions. In this report, 5 patients with hereditary hemorrhagic telangiectasia received rutin for two to three years without significant alteration of their bleeding tendencies. There was no evidence of diffusely increased capillary fragility as manifested by the Rumpel-Leede or Göthlin indexes. The striking tendency toward spontaneous variations in the extent of the lesions and bleeding in these patients is re-emphasized. One additional case of increased capillary fragility of undetermined etiology with a history of bruising on minimal trauma was studied. This patient had strongly positive capillary fragility tests which were decreased to normal, as were her clinical bleeding phenomena, following rutin therapy using 50 mg three times daily. Vitamin C given prior to rutin had not altered the clinical state.

4644
Committee on Surgery, National Research Council
SYMPOSIUM ON BURNS; NOVEMBER 2-4, 1950. 1951. 211p. (NP-3252)

Numerous authoritative papers and discussions are presented on the following subjects: scope of the burn problem, radiation component of atomic bomb explosions, physiologic problems concerned with flame throwers, laboratory production of high- and low-temperature burns, fluid and electrolyte requirements in burns, renal and pulmonary disturbances accompanying severe burns, endocrine response, treatment of the burned areas, infections, nutritional care, plastic repair, and disaster problems of burn care.

RADIATION EFFECTS

4645
Cancer Research Inst., New England Deaconness Hospital, Boston
THE MECHANISM OF ACUTE HYPOTENSION FOLLOWING TOTAL BODY IRRADIATION. Philip O'B. Montgomery and Shields Warren. [nd] 18p. (AECU-1488)

The effect of doses of 1500, 2000, and 2500 r of total-body x irradiation upon the blood pressure, blood volume, and hematocrit were similar regardless of the dose. Blood pressures, hematocrits, and blood volumes of rats irradiated with 1500 r 30 hr after cutting the spinal cord at the level of C6 were the same as found in nonirradiated controls that had undergone the same operation. Bilaterally adrenalectomized rats after 1500 r total-body irradiation exhibited behavior identical to that shown by normal rats given the same dosage. It is concluded that the cause of the immediate hypotension following large doses of total-body irradiation is depression of the nervous system.

4646
Argonne National Lab.
EFFECTS OF X IRRADIATION IN NEWBORN RATS. S. Phyllis Stearner and Emily J. B. Christian. June 1951. 20p. (AECU-1508; UAC-404)

Newborn rats were x-irradiated shortly after birth (½ to 5 hr) and at 1 or 2 days of age. Radiation doses ranged from 400 to 1000 r, and exposures were made at 6, 40, and 80 r/min. Effects of x irradiation upon survival indicated that the newborn rat was more radiosensitive than the adult; but resistance increased rapidly after birth, and at 2 days the sensitivity was only slightly less than that reported for adults. A higher and earlier death rate followed exposure

of ½- to 5-hr old rats to 600 r at 80 r/min than that observed in groups exposed at 6 r/min. No effect of variation in dose rate was observed after exposure to 400 and 800 r. Exposure to 1000 r, however, produced a shorter mean survival time when delivered at 6 r/min than when delivered at higher rate. Animals exposed at 24 hr after birth showed no dose-rate effects upon survival and gross-pathology with any amount of exposure. Generalized edema, hyperemia, and renal hemorrhages were prominent autopsy findings at 1 to 2 days after irradiation in animals exposed within 5 hr after birth. Later gross changes were typical of those that accompany acute radiation deaths. Hemorrhages developed in the cerebrum within the first day and in the cerebellum and medulla after 5 to 7 days.

4647

Brookhaven National Lab.

EFFECTS OF RADIATION ON BIOLOGICAL SYSTEMS. A. H. Sparrow and B. A. Rubin. Feb. 15, 1951. 54p. (BNL-97)

This report is a summary of work done in the field of radiobiology to the present time. Types of radiation, dosage units, energy-transfer mechanisms, distribution of energy, target theory of radiation, relationship between chemical and biological effects of radiation, effects of radiation on microorganisms, cytological effects, genetic effects, and carcinogenesis of radiation, physiological effects, embryological and developmental effects, and radiosensitivity of organisms are discussed. 222 references.

4648

ADRENAL SHIELDING AND SURVIVAL OF RATS AFTER X-IRRADIATION. Abraham Edelmann. Am. J. Physiol. 165, 57-60(1951) Apr. 1.

Lead shields placed around the adrenal glands of rats appreciably decreased the number of deaths following 700 or 800 r of whole-body x radiation. It is thought that the shielding prevents direct radiation damage to the glandular cells so that they retain their ability to respond to nonspecific stress. The gland was extruded from the shield by 3 months, probably because of the formation of connective tissue within the shield. Enucleation with degeneration of the medulla appeared to result. It is thought that available histological and histochemical techniques do not reveal the true radiosensitivity of the adrenal cortex. (auth)

4649

COMBINED EFFECTS OF X-RAYS AND TEMPERATURE ON MITOSIS. L. F. La Cour. Nature 167, 318-19(1951) Feb. 24. (Letter to the editor)

Recent experiments were conducted to test whether normally charged heterochromatin cold-starved of desoxyribose nucleic acid could be directly broken at metaphase by x rays. Plants of Trillium grandiflorum were chilled at 0 to 3°C for 3 days prior to irradiation of the root tips. Results show that (1) the combined effect of cold and x rays is to slow down mitosis and, when applied simultaneously, to suppress it, (2) chromosome stickiness was not present, and (3) there was no breakage following irradiation.

4650

CRITICAL INTRODUCTION TO THE STUDY OF THE TARGET THEORY. I. GENERAL OUTLINE OF THE THEORY. Aldo Piergrossi. Radiologia med. 37, 389-411 (1951) May. (In Italian)

The "target" or "hit" theory of the action of radiations on living matter is discussed.

4651

CRITICAL INTRODUCTION TO THE STUDY OF THE "HIT" THEORY. PART II. RADIOBIOLOGICAL EFFECTS AND DENSITY OF IONIZATION. Aldo Piergrossi. Radiologia med. 37, 471-88(1951) June. (In Italian)

In this second part of a general outline of the "target" or "hit" theory of the biological action of ionizing radiations, effects of various spacial distributions of ions and the concept of elementary radiosensitive volumes within the living cell are described.

4652

Naval Radiological Defense Lab.

THE RELATIONSHIP OF RADIATION DOSE TO LETHALITY AMONG EXERCISED ANIMALS EXPOSED TO ROENTGEN RAYS (Technical Objective AW-6). D. J. Kimeldorf and D. C. Jones. July 11, 1951. 18p. (AD-321(B))

The mortality of exercised irradiated rats was compared with that of nonexercised irradiated rats following x-ray doses ranging from 200 to 1000 r. Swimming to exhaustion under standard conditions of testing constituted the exercise. Where exposure to x rays if followed by daily exhaustive exercise the mortality is significantly greater than with irradiation alone. For exercised irradiated rats LD_{50} was found to be 510 r and for nonexercised irradiated rats LD_{50} was 710 r, 28% higher. The mortality is not affected by exercise undertaken prior to irradiation. Experiments exposing the rats daily to water of different temperatures without exercise had no influence upon the postirradiation mortality of exercised irradiated animals, showing that the specific environment associated with the method of exercise is not responsible for the mortality increase observed with exercise.

RADIATION HAZARDS AND PROTECTION

4653

Los Alamos Scientific Lab.

RADIOLOGIC HAZARDS PREDICTED FOR A GIVEN HEIGHT BURST OF AN ATOMIC BOMB. Charles H. Perry. Apr. 6, 1951. Decl. July 30, 1951. 14p. (AECD-3210; LADC-991)

An appraisal is made of the radiologic hazard created by a 1000-ft high air burst of a nominal sized nuclear bomb. Three sets of graphs are included which show the relations between dose rate (mr/hr), time post-shot, and distance from Ground Zero for a soil having given constituents. Estimates are given for fall-out γ activity for distances up to about 200 miles from Ground Zero immediately after fallout. It is pointed out that the radiologic hazard due to fallout in the example cited is insignificant; further, that the radiologic hazard from similar nuclear bombs bursting at different heights above the ground will vary to a considerable extent. (auth)

4654

Brookhaven National Lab.

RADIOLOGICAL MONITORING FOR CIVIL DEFENSE. J. B. H. Kuper. [nd] 7p. (AECU-1507)

Suggestions are made for a practical radiological monitoring system for civil defense. It is recommended that there be two types of monitoring teams in widely differing numbers, with different levels of training and types of equipment: about 30,000 teams of "wardens" whose function is the simple decision that an area is clean, and 150 to 200 teams of "surveyors" who should be able to evaluate dosage from a mixed radiation field and to compute permissible working times for emergency personnel. General suggestions are made on the equipment and training necessary for each group.

4655

Arthur D. Little, Inc.

REPORT ON DESIGN FOR VOLUME PRODUCTION OF COMBUSTIBLE RADIOACTIVE WASTES BY INCINERATION. June 30, 1950. 187p. (ALI-C-57867)

A final report is presented which includes design drawings, specifications, heat and material balances, process description, operating information, and cost estimates sufficiently detailed to permit contract negotiations for the construction of a radioactive-waste incinerator. A description is also provided of experimental work carried out on the choice of a scrubbing solution, various methods of dust collection and their efficiencies, and the settling of incinerator ash.

4656

Kellex Corp.

PROGRESS REPORT; SECOND QUARTER, 1951; DEVELOPMENT OF LABORATORY WASTE DISPOSAL UNIT; JOB 24-A. July 16, 1951. 18p. (KLX-1352)

Brief statements are made concerning the status of various phases of the program to develop a laboratory waste-disposal unit using ion exchange resins. The prototype unit was completed and radiation measurements at several millicurie loadings were made. These measurements indicated that for the anticipated operating conditions the spent cartridge would require little if any shielding during shipping. Accelerated tests in the disposable ion-exchange cartridge and laboratory column runs have been carried out to demonstrate optimum resin combination and the efficiency of the waste-disposal unit. A resin combination selected for use in the cartridge of the waste-disposal unit represents the stoichiometric resin quantities to remove all ions from solution. Studies were made on the cartridge using the chosen resin proportion to decontaminate feeds of unseparated fission products plus 5000 ppm $NaNO_3$. The results were comparable to those obtained with laboratory columns under comparable conditions. To obtain a satisfactory filter to be used in the unit cartridge various filter materials were tested for stability under treatment with organic solvents, distilled water, acids, bases, and salt solutions of various concentrations. An evaluation has been made of the National Aluminate Corporation mixed-bed ion-exchange unit.

4657

Central Aerosol Labs., Columbia Univ.

STUDIES ON FILTRATION OF MONODISPERSE AEROSOLS. Victor K. La Mer. Mar. 31, 1951. 128p. (NYO-512)

A detailed report is presented of an extensive study of aerosols with particular regard to (1) production, (2) the growth method of determining particle size, and (3) the filtration of fine monodisperse particles (both experimental results and theoretical concepts). The filter penetration characteristics of four filter papers have been investigated as a function of the particle radius using dioctyl phthalate (DOP), oleic acid, and stearic acid. The radii of the monodispersed aerosols ranged from 0.50 to as small as 0.02 μ in some cases. A review of the factors influencing turbulent vs. laminar flow and pressure drop through porous media is given, and its bearing on the "pinhole theory" is discussed. The reliability of the growth method for determining particle sizes in the sub-Tynall region has been confirmed by an extensive series of measurements.

4658

ATOMIC BOMB AND AIR RAID PROTECTION. II. A. N. Gerritsen. Wetenschap en Samenl. 5, 8-11(1951) Jan. (In Dutch)

Data on effects of atomic bomb explosions taken from Bull. Atomic Scientists 6, 225(1950) are illustrated by considering possible devastation in Amsterdam, Netherlands. The policy adopted by the Dutch government for protection against air bombardments is briefly outlined and criticized.

4659

THE DEVELOPMENT OF PROTOTYPE MODEL RESEARCH ON ATMOSPHERIC POLLUTION PROBLEMS. Gordon H. Strom and William T. Ingram. Am. Ind. Hyg. Assoc. Quart. 12, 59-63(1951) June.

Work is under way on construction of a meteorological wind tunnel in which atmospheric motions affecting pollution will be simulated. Points to be considered are influence of height of building, nonuniform characteristics in the lower layer of the atmosphere, and scale factors. Atmospheric field studies for correlation are under way. Various types of tunnels used in the past are compared.

4660

OFF-SITE DISPOSAL OF RADIOACTIVE INCINERATOR RESIDUES BY SOLID FLUXES. Richard C. Corey, Harry Perry, and Cecil H. Schwartz. Am. Ind. Hyg. Assoc. Quart. 12, 52-7(1951) June.

Work is carried on preliminary to construction of an incinerator for off-site use to handle heterogeneous combustible laboratory wastes containing radioisotopes. It was found that fluxing radioactive residues with molten NaOH is a safe means of disposal.

RADIATION SICKNESS

4661

Clinton Labs.

AN ATTEMPT TO DETECT SMALL AMOUNTS OF IRRADIATION INJURY. M. B. Cupp. Sept. 1945. Decl. May 28, 1951. 6p. (AECD-3183; MonH-21)

Results of recent tests indicate that radiation injury undetectable by the blood test may nevertheless cause other changes to occur later. Hence a more sensitive test for irradiation injury is needed. Since the blood picture in subjects with leukemia can be modified with relatively small doses of radiation, leukemic blood was used in a search for a better method. Presuming that at least part of the destruction caused by radiation on blood cells is due to the action of photodecomposition products, the plan visualized was to take serum from animals exposed to radiation and inject it into animals having leukemia. A number of the most likely conditions were tried. Heavily irradiated donors were used; large amounts of serum were injected; and strongly leukemic recipients were employed. Nevertheless, all results were negative. No leucocyte fall was noted which exceeded normal variation. The findings, while negative from the point of view of providing a sensitive test procedure, are positive in the sense that the study failed to reveal evidence of a decomposition product in blood serum which would add to the destruction of leucocytes. (auth)

RADIOGRAPHY

4662

Argonne National Lab.

RADIOAUTOGRAPHY. J. S. Arnold. Jan. 1951. Decl. June 5, 1951. 4p. (AECD-3191)

In an effort to demonstrate the migration of Pu from its initial site of deposition 14 rats were given subtoxic amounts of Pu citrate intravenously and were sacrificed at weekly intervals. By radioautographic means it has been definitely shown that the Pu migrated from its initial endosteal site of deposition into the cortical bone by the process of having new nonisotope-containing bone laid down over it. Further, it seemed that the Pu that had migrated into the cortex was concentrated on the surface of the laminae of bone or in the cement substance between laminae. In a dog that had been given Pu 2 years before sacrifice, the retained Pu was distributed in a rather spotty manner in both trabecular and cortical bone. U^{233}, which had been administered intravenously as the nitrate, was found to appear in aggregates in the macrophages of the spleen of mice. A photograph of this phenomenon is reproduced in the report. The kidney accumulation of injected U^{233} appeared to be in

the proximal convoluted tubes in the form of a cast deposition. The results of tests with NTA and NTB liquid nuclear track emulsions show that there is definite advantage in their use for localization studies.

RADIOTHERAPY

4663

A MANUAL OF ARTIFICIAL RADIOISOTOPE THERAPY. Paul F. Hahn, ed. New York, Academic Press, Inc., 1951. 310p.

Sixteen authors contribute to this textbook of therapeutic uses of radioisotopes. Hahn describes his method of treatment of leukemias and lymphoblastomas using Mn^{52} and Au^{198} and his development of colloidal Au by direct injections for palliative treatment of cancers and by intraperitoneal injection for peritoneal implantations. Included are chapters on uses of specific radioisotopes, terminology, standards, dosimetry, isotope procurement, health physics, instruments, autoradiography, and the setting up of a hospital isotope program.

4664

RADIOACTIVE COLLOIDAL GOLD IN MACROPHAGES AND SEROUS EXUDATE IN PERITONEAL FLUID OF SARCOMA BEARING MOUSE. Horace Goldie, Lincoln B. Calvin, Homer Nash, and Paul F. Hahn. Proc. Soc. Exptl. Biol. Med. 76, 480-84(1951) Mar.

Experiments were conducted on Sarcoma 37-inoculated mice to discover the relative proportion of radioactivity in each of two fractions of peritoneal fluid after treatment with colloidal Au^{198}. It was found that the ratio of Au stored in macrophages to that in serous exudate increased with higher doses of radioactive Au.

TOXICOLOGY STUDIES

4665

Argonne National Lab.

THE EFFECT OF BAL ON THE DISTRIBUTION AND METABOLISM OF P^{32} AND Sr^{90}. Walter E. Kisieleski and William P. Norris. Apr. 1951. 7p. (AECU-1368; 383)

The effectiveness of 2,3-dimercapto-1-propanol (British antilewisite, BAL) in increasing the elimination of injected P^{32} and Sr^{90} in mice was investigated. It is concluded that BAL is essentially without effect although, in the case of P^{32}, the rate of uptake in bone appears to be reduced during the first hour. No such difference could be demonstrated after 24 hr. (auth)

4666

PNEUMOCONIOSIS; BERYLLIUM BAUXITE FUMES. Arthur J. Vorwald, ed. N. Y., Harper and Brothers, 1950. 454p.

This is a collection of data, through 1947, on the problem of the effects of Be and bauxite on workers. It includes a general bibliography of 684 references on Be.

4667

REVERSIBLE POISONING OF NERVE FIBERS BY HEAVY-METAL IONS. J. Del Castillo-Nicolau and H. J. Hufschmidt. Nature 167, 146-7(1951) Jan. 27.

A series of experiments has been performed in order to investigate the influence of thiolic substances on nerve fibers poisoned with heavy-metal ions. Bundles of motor fibers isolated from the sciatic nerve of R. temporaria have been employed, still attached to the gastrocnemius muscle. The results so far obtained are summarized as follows. Salts of Cd, Cu, Hg, Ag, and U produce an inhibition of nerve excitability. When blockage of the nerve fibers has been definitely established, treatment with cystein or glutathione causes almost instantaneous recovery of excitability. Treatment with 2,3-dimercaptopropanol (BAL) causes three main effects: (1) BAL by itself causes a slow but irreversible loss of excitability. (2) A nerve bundle which has been treated with BAL for a short time exhibits high resistance to the action of Ag ions. (3) Nerve fibers poisoned with Ag ions regain their excitability within a few seconds if treated with BAL.

TRACER APPLICATIONS

4668

Argonne National Lab.

[THE PRODUCTION OF C^{14}-LABELED DEXTRAN]; PERSONAL COMMUNICATION FROM A. M. BRUES TO SIR LIONEL WHITBY, DEPARTMENT OF MEDICINE, UNIVERSITY OF CAMBRIDGE. (Based on ANL-4625) A. M. Brues. July 12, 1951. 3p. (AECU-1354; UAC-408)

The production of C^{14} uniformly-labeled dextran by fermentation, using the bacterium, Leuconostoc mesenteroides, and the biosynthesis of C^{14} sucrose, required in the fermentation, from $C^{14}O_2$ by excised Canna leaves are described. Dextran with an absolute activity of 116.8 $\mu c/g$ was released for use in animal studies as a dry solid. Dextran for use on human patients with an activity of 5.92 $\mu c/g$ is being prepared as a 6% isotonic water solution.

4669

Radiological Research Lab., Columbia Univ.

THE MOUSE THYROID AND RADIOACTIVE IODINE (I^{131}); II. THE EXCRETION RATE OF RADIOACTIVE IODINE FOLLOWING ITS INJECTION INTO THE ADULT NURSING AND NON-NURSING MOUSE, AND ITS RATE OF ABSORPTION BY THE SUCKLING YOUNG. Roberts Rugh. Mar. 1, 1951. 27p. (NYO-1545)

The second in a series of papers on the mouse thyroid and carrier-free NaI^{131} dealing with the excretion of subcutaneously injected radioiodine as it is altered by lactation and nursing a litter is presented. Excretion in the control is very rapid. By 4-hr post injection, 66% of the radioiodine is lost and by 48 hr only 8% remains. If the mouse is nursing a litter the excretion rate is reduced to about 25% within the first 4 hr. The bulk of the retained iodine is being transferred through the milk. There is no direct correlation between the concentration of injected by 48 hr, regardless of its size, there was found more I^{131} than was retained by the mother. The dose, not the concentration, to any litter member never exceeded 5% of the total dose injected into the mother. The concentration (i.e., $\mu c/g$ of body weight) of radioiodine in the individual litter members varied considerably, and was somewhat correlated with the dose to the mother.

4670

CLINICAL AND EXPERIMENTAL STUDIES OF INTRACRANIAL TUMORS WITH FLUORESCEIN DYES WITH AN ADDITIONAL NOTE CONCERNING THE POSSIBLE USE OF K^{42} AND IODINE 131 TAGGED HUMAN ALBUMIN. G. E. Moore, C. M. Caudill, J. F. Marvin, J. B. Aust, S. N. Chou, and G. A. Smith. Am. J. Roentgenol. Radium Therapy 66, 1-8(1951) July.

Sodium fluorescein has proved valuable clinically for the identification of brain-tumor tissue at operation; in experimental animals it has been used in studies of disruption of the blood-brain barrier. Use of radioactive diiodofluorescein is suggested for the latter purpose. Radioactive diiodofluorescein was not found accurate enough as sole diagnostic test for localization of brain tumors. The merits and disadvantages of I^{131}-albumin and K^{42} as tracer agents are discussed.

4671
THE FIXATION OF CARBON DIOXIDE BY GROWING AND NONGROWING YEAST. Irvin E. Liener and Donald L. Buchanan. J. Bact. 61, 527-34(1951) May.

Yeasts were cultured in closed systems containing $C^{14}O_2$ in order to determine the percentage of total carbon (in that fraction that had been acid-washed and ether-extracted) originating from CO_2. Growing yeast cells rapidly fixed CO_2, obtaining as much as 5% of their total carbon from the air. After an exposure of 10 days under the same CO_2 tension, "nongrowing" cells contained only 1% fixed carbon. At low concentrations of CO_2, the uptake of this carbon by growing yeast is proportional to the CO_2 concentration. When the CO_2 concentration exceeds 5%, the percentage of the total carbon represented by fixed carbon becomes essentially constant. (auth)

CHEMISTRY

4672
Argonne National Lab.
PREPARATION OF SOME PROTACTINIUM COMPOUNDS AND THE METAL. P. Sellers, S. Fried, R. Elson, and W. Zachariasen. Apr. 6, 1951. Decl. May 24, 1951. 10p. (AECD-3167; ANL-WMM-827)

A detailed discussion is given of the preparation and identification of Pa metal, a hydride, tetrafluoride, monoxide, dioxide, and an oxysulfide. A nitride and a volatile fluoride, bromide, and iodide have been prepared but not definitely identified. Small diagrams illustrate the necessary apparatus.

4673
Argonne National Lab.
THE CHLORO COMPLEXES OF RUTHENIUM(IV). Philip Wehner and J. C. Hindman. Apr. 30, 1951. 34p. (AECU-1357; UAC-385)

Spectrophotometric studies have been made of the ionic species formed on addition of chloride to Ru(IV) in perchloric acid solution. Depending on the acid and chloride concentration a series of color changes occur: R(IV) (reddish) → violet → yellow (Y(II)) (low chloride, low acid); R(IV) (reddish) → yellow (Y(IA) and Y(IB)) → violet → yellow (Y(II)) (high chloride, high acid). Under a variety of conditions a yellow complex, Y(III), is observed to grow at the expense of the Y(II) complex and eventually to exist in equilibrium with it. At very high acidities two more species, Y(IV) and Y(V), are slowly formed in minor amounts. The formula $[RuCl_3H_2O(OH)_2]^-$ has been deduced for Y(II), and this has been used in the assignment of formulas to other complexes as follows: violet, $[RuCl_4(H_2O)_2(OH)_2]$; Y(III), $[RuCl_4(OH)_2]^{--}$. The violet complex is observed, usually as a transitory intermediate, under almost all conditions at which Ru(IV) and Cl^- react at finite rates. Support for the belief that polymers of Ru(IV) exist in perchloric acid solutions has been obtained by a study of the effect of the initial Ru(IV) concentration on the kinetics of formation of the violet complex. 8 tables. 7 graphs.

4674
Argonne National Lab.
REDUCTION OF NIOBIUM(V) AND (IV) AND TANTALUM(V) IN SOLUTION. Robert E. Elson. Apr. 20, 1951. 14p. (AECU-1384; UAC-357)

Evidence has been obtained for two one-electron reductions of Nb(V) and of a one-electron reduction of Ta(V) mostly in oxalate and tartrate solutions at large negative potentials. The resulting oxidation states have been ascribed to Nb(IV) and (III) and Ta(IV), respectively. Spectral changes in the ultraviolet and visible regions and polarographic reductions were observed.

4675
Metal Hydrides, Inc.
CLASSIFICATION AND PROPERTIES OF HYDRIDES. Thomas R. P. Gibb, Jr. Sept. 1, 1948. 5p. (AECU-1427)

The classification of hydrides into (1) saline (alkali metals, Ca, Sr, and Ba), (2) polymeric (Be, Mg, Al, Cu group, and Zn group), (3) metallic (periodic groups headed by Ti, V, Cr, Fe, Co, Ni, lanthanides, and actinides), and (4) volatile (metalloids, B, Si, Ga, In, and Tl) is followed by a brief discussion of the structures and physical properties, particularly the thermal dissociation, of each classification.

4676
Ames Lab.
THE DISCRIMINATION OF ISOTOPIC CARBON BY ENZYMES. D. W. Racusen and S. Aronoff. [nd] 18p. (AECU-1490)

It has been shown recently that an enzyme may be able to discriminate between isotopic carbons in in vivo reactions under some circumstances. Furthermore, it has been noted that isotopic discrimination may occur in relatively simple nonenzymatic reactions. Various types of isotopic discrimination are discussed and classified in the present report. The steric conditions in which discrimination by an enzyme system cannot occur are set forth. Experimental evidence is given to support the thesis that molecules having a twofold (or greater) axis of symmetry cannot be operated upon by discriminatory enzyme action. Malic acid-β-C-14 has been synthesized and used in a degradation scheme which determines the β-carboxyl. A simple, rapid synthesis of cyanide from Ba carbonate is described. (auth)

4677
North American Aviation, Inc.
MOLECULAR FORM OF VAPORIZING SODIUM. M. H. Feldman. May 21, 1951. 18p. (NAA-SR-123)

The vaporization of sodium is considered. The heat of vaporization, the rate of dimerization, the molecular form of sodium at the time of vaporization, and the effects of extreme pressure are considered from the point of view of the absolute reaction rates theory. Liquid sodium is composed of monatomic ions; vaporization is by way of monatomic sodium atoms; these atoms subsequently dimerize to a degree dependent on the temperature and the pressure. (auth)

4678
Pennsylvania State Coll.
A POTENTIOMETRIC STUDY OF BETA-DIKETONE CHELATION TENDENCIES; III. METAL CHELATE COMPARISONS. LeGrand G. Van Uitert, Bodie E. Douglas, and W. Conard Fernelius. May 2, 1951. 58p. (NYO-727)

Data for the chelation of Be, Fe(II), Co(II), Zn, Mn(II), Cd, and Mg with the diketones acetylacetone, benzoylacetone, dibenzoylmethane, benzoylfuroylmethane, thenoylfuroylmethane, benzoyltrifluoroacetone (except Be), and benzoylthenoylmethane (Cd only) have been obtained. With the exception of Cd, those metal ions which can become six coordinate form insoluble double salts, $NaMCh_3.solvate$, in this solution. The order of increasing formation constants for the several metal chelate compounds are as fol-

lows: Mg, Cd, (Mn + Zn), Co, Ni, Fe, Cu, Be. The chelate compounds of this series are less stable than the comparable hydroxy compounds. The methyl group appears to have an inhibiting effect toward chelation of a second diketone that is quite unexpected. It is possible to predict the formation constants for comparable β-diketone chelate compounds with considerable accuracy. Data for Cu(II) and Ni(II) have been reported in NYO-725 (NSA 5-4088) and NYO-726 (NSA-5-4089) of which this report is a continuation. 11 tables. 22 graphs.

4679

Atomic Energy Research Establishment, Harwell, Berks. (England)

A BIBLIOGRAPHY ON TECHNETIUM. June 1951. 11p. (AERE-Inf/Bib-74)

122 references on technetium are listed, as culled from Nuclear Science Abstracts and Chemical Abstracts. Both reports and published literature are included.

4680

THE REACTION BETWEEN DIBORANE AND ANHYDROUS HYDRAZINE. H. J. Emeléus and F. G. A. Stone. J. Chem. Soc., 840-1(1951) Mar. (Notes)

Anhydrous hydrazine has been found to react with excess of diborane at 0°C to form H_2 and a white hygroscopic solid which was nonvolatile and insoluble in a variety of solvents. The reactants combined in unusually variable proportions in different experiments (B_2H_6:N_2H_4 = 1:0.78 to 0.97), and the amount of H_2 formed also varied. This suggests that the product may have been a mixture. The simplest and most probable initial reaction would be one in which the N atoms of hydrazine became coordinated to borine radicals, forming either $H_3B{\cdot}NH_2{\cdot}NH_2$ or $H_3B{\cdot}NH_2{\cdot}H_2N{\cdot}BH_3$, or both. When the initial product was hydrolyzed and the hydrazine was estimated in the hydrolyzate, the amount found corresponded closely to the total N content of the solid. Another indication that there was no cleavage of the N – N bond of hydrazine in this reaction is that no borazole was formed when the solid was heated to 180°. The initial product had strong reducing properties, decolorizing permanganate instantaneously and precipitating Ag from $AgNO_3$ solution. It also exploded when heated in air or on treatment with concentrated sulfuric acid.

4681

THE STATISTICAL MECHANICAL THEORY OF SOLUTIONS. I. John G. Kirkwood and Frank P. Buff. J. Chem. Phys. 19, 774-7(1951) June.

A general statistical mechanical theory of solutions is developed with the aid of the theory of composition fluctuations in the grand canonical ensemble. It is shown that the derivatives of the chemical potentials and osmotic pressure with respect to concentrations, the partial molar volumes, and compressibility may be expressed in terms of integrals of the radial distribution functions of the several types of molecular pairs present in the solution. Explicit coefficients of a q-fraction expansion of the thermodynamic variables are presented in a detailed treatment of the two-component system. (auth)

ANALYTICAL PROCEDURES

4682

Wisconsin Univ.

COMPARISON OF DIFFERENTIAL AND ORDINARY PROCEDURES FOR SELECTING THE END POINT IN HIGH FREQUENCY TITRATIONS. W. J. Blaedel and H. V. Malmstadt. [nd] 24p. (AECU-1525)

Three different titration techniques using recently described high frequency titration instruments (Blaedel and Malmstadt, Anal. Chem. 22, 734, 1413(1950)) are compared. The differential and ordinary titration methods are complementary, each having its own advantages. Generally, the constant-flow differential method using a constant-flow burette and differential frequency meter is more rapid than the ordinary method. Various forms of curvature of the titration curves which often cause serious error by the ordinary method are of no consequence by the differential method. The differential method is superior to the ordinary method for resolving two end points which are close together. When conditions are such that the wings of the curve are actually straight lines, but the end point is very poor, the ordinary method is sometimes superior to the differential method. A burette is described which can be used either in the normal manner or to deliver solution at a uniform and low rate of addition. (auth)

4683

Los Alamos Scientific Lab.

THE MICRODETERMINATION OF AZIDE BY A KJELDAHL PROCEDURE. Leonard P. Pepkowitz. [nd] 8p. (AECU-1536)

A rapid micro procedure for the determination of azide N is presented. The procedure is advantageous in that it is simple and accurate and in that only small quantities of explosive materials need be handled. The procedure is based on the fact that one-third of the azide N, in H_2SO_4 media and in the presence of a reducing agent, is liberated as NH_3 during the digestion process. The remaining N is liberated as N_2 gas. The reaction is quantitative and, in spite of the poor factor, offers a satisfactory micro procedure. A method for correcting for nonazide N in the sample also is described. (auth)

4684

Knolls Atomic Power Lab.

THE DETERMINATION OF HYDROGEN IN ALKALI METALS. Leonard P. Pepkowitz. May 1, 1951. 12p. (KAPL-563)

A recent report by O. B. Holt (ANL-4388) regarding the microgasometric method of Pepkowitz and Proud for the determination of hydrogen in a NaK alloy contained results divergent from those of the original paper (Pepkowitz and Proud, Anal. Chem. 21, 1000(1949)). An attempt has been made to reproduce the conditions and experiments described in ANL-4388, but the original conclusions are again reached. Quantitative recoveries of known amounts of H_2 added as sucrose were obtained with either Na, K, or NaK. The experiment described in ANL-4388 to demonstrate the reabsorption of H_2 was repeated but with opposite results.

4685

COLORIMETRIC ESTIMATION OF VARIOUS METAL DERIVATIVES OF SODIUM DIETHYLDITHIOCARBAMATE. René J. Lacoste, Mason H. Earing, and Stephen E. Wiberley. Anal. Chem. 23, 871-4(1951) June.

An investigation was undertaken to show that trace quantities of many elements can be accurately determined colorimetrically using this reagent. Bismuth, cobalt, chromium, iron, nickel, and uranium as well as copper can be determined colorimetrically using this reagent and subsequent extraction into a chloroform solution. The extraction is quantitative over a wide range of acidity. Application of this method to the determination of bismuth should be particularly valuable. This work shows that all the elements mentioned will interfere in the determination of copper unless provision is made for their removal; by controlling the acidity of the solution from which the extraction is made, copper can be separated successfully from uranium and chromium. (auth)

4686

INFRARED DETERMINATION OF METHYL DEUTERIDE. APPLICATION TO ANALYSIS OF DEUTERIUM OXIDE.

Theodore L. Brown and Richard B. Bernstein. Anal. Chem. 23, 673-4(1951) Apr.

This note reports an infrared spectrophotometric method for the determination of CH_3D in methane, and its application to the determination of deuterium in water. The absorbency of the 2204 cm^{-1} band of CH_3D is plotted against the partial pressure of CH_3D. The per cent CH_3D in the CH_4 is equal to the atom per cent deuterium in the water. The minimum limit of detectability of CH_3D in CH_4 (and thus of deuterium oxide in water) was investigated using samples of ~1% deuterium oxide. For a 100-mg sample, 0.4 at. % deuterium may be detected with certainty.

4687

METHODS OF FLUORINE AND FLUORIDE ANALYSIS—I. F. E. McKenna. Nucleonics 8, No. 6, 24-33(1951) June.

Analytical determination of fluoride by the lead chlorofluoride, calcium fluoride, Al, Fe, La, Y, Ce, and Th methods are considered in Part I of this three-part comprehensive review of the literature from 1816 to 1950. 146 references.

4688

SPECTROGRAPHIC DETERMINATION OF SILICON IN URANYL NITRATE SOLUTIONS. F. T. Birks. Anal. Chem. 23, 793-4(1951) May. (Notes on Analytical Procedures)

A number of uranyl nitrate solutions, each containing about 300 mg of U/ml of dilute nitric acid solution, were examined for Si. Because the only impurity element sought was Si and there were sensitive Si lines located in a region free from an excessive number of U lines, a direct burn procedure was employed and U itself was used as an internal standard. The preparation of standards and procedure of testing are explained. Results were expressed as parts per million of Si in U_3O_8. Results of quadrupole tests of four samples are tabulated.

4689

ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM. George Telep and D. F. Boltz. Anal. Chem. 23, 901-3(1951) June.

Ultraviolet adsorption spectra of inorganic complex compounds are being studied with the purpose of developing new or improved spectrophotometric methods of analysis. It was desired to ascertain the wavelength of maximum absorbency, the optimum concentration range for V, the effect of the concentration of reagents, and the effect of diverse substances for the peroxyvanadic acid system. Although pervanadyl ions exhibit strong general absorption in the ultraviolet region, peroxyvanadic acid had a characteristic absorbency maximum at 290 mμ in addition to that at 460 mμ. Absorptiometric measurement gives somewhat greater sensitivity in the ultraviolet than in the visible region. The tolerances for dichromate and titanic ions are larger when the ultraviolet spectrophotometric method is used. Ferric and nitrate ions are the main interfering ions whose effect cannot be circumvented by using a compensating blank. The general procedure which was developed is suitable for the determination of 0 to 125 ppm of V and should be applicable to a variety of samples. The existence of an ultraviolet absorbency maximum for peroxyvanadic acid is especially significant. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

4690

Carbide and Carbon Chemicals Co., K-25

THE CRYSTAL STRUCTURE OF URANIUM TETRAFLUORIDE. R. D. Burbank. June 6, 1951. Decl. Aug. 2, 1951. 14p. (AECD-3216; KZ-6682)

UF_4 has been analyzed by Fourier refinement of the U parameters reported by Zachariasen (Acta Cryst. 2, 388 (1949)) followed by determination of the F parameters by crystal chemical and packing considerations. The structure is an ionic one in which each U atom is surrounded by eight F atoms, and each F atom is situated between two U atoms. There are two types of U-8F coordination groups which are geometrically similar to the arrangement in the $[Mo(CN)_8]^{-4}$ ion. The array of U-8F groups in space is related to the structures of $ZrSiO_4$, $ThCl_4$, and UCl_4. The compounds UF_4, U_4F_{17}, and U_2F_9 have a number of structural and chemical similarities. (auth)

4691

Knolls Atomic Power Lab.

THE ORIGIN OF ANOMALOUS X-RAY DIFFRACTION SPECTRA IN GRAPHITE. Joseph S. Lukesh. [nd] 8p. (AECU-1496)

The appearance in graphite-powder diffraction patterns of weak diffraction spectra which cannot be accounted for on the basis of the classical hexagonal graphite structure has been observed by several investigators. These have been interpreted by Lipson and Stokes (Proc. Roy. Soc. (London) 181A, 101(1942)) as being due to a rhombohedral modification which differs from the hexagonal form in the sequence of layer stacking. In order to test whether or not the anomalous x-ray spectra could be caused by impurities, experiments have been conducted in which bromine atoms were deliberately introduced into a highly purified graphite. The appearance, after treatment, of spectra having the same Bragg angle as the rhombohedral spectra observed in natural graphite is suggestive, but not conclusive, of a possible common impurity origin for the two phenomena. The failure of halide acid treatment to remove the lines in natural material even after the graphite has been purified to zero ash might be explained if a volatile impurity remains in the structure, possibly iron chloride or even chlorine itself. Several other anomalous spectra appear after the bromide treatment, which are not accountable on the basis of the rhombohedral cell. Insufficient data have been obtained as yet to allow interpretation of these additional spectra.

4692

Argonne National Lab.

THE CRYSTAL STRUCTURE OF PLUTONIUM SESQUICARBIDE. W. H. Zachariasen. Feb. 1951. 9p. (ANL-4631)

Detailed data for the crystal structure determination of Pu_2C_3 are given. Recent identification of the isostructural U_2C_3 confirm the presented investigations. Pu_2C_3 is cubic with eight molecules per unit cell and a unit cell constant $a = 8.129 \pm 0.001$ A. The calculated density is $\rho = 12.70$. The space group is $I\bar{4}3d(T_d^6)$. The Pu atoms are in 16-fold positions with $x = 0.050 \pm 0.003$. A reasonable structure is obtained with the carbon atoms in 24-fold positions with $y = 0.280$. Each Pu atom is bonded to nine C atoms, three being at a distance of 2.48 A, three at 2.51 A and three at 2.84 A. The shortest Pu–Pu distance is 3.35 A. The carbon atoms are bonded together by covalent bonds to form C_2-groups.

4693

Columbia Univ.

ATOMIC DISPLACEMENTS AND CRYSTALLOGRAPHIC MECHANISM IN DIFFUSIONLESS TRANSFORMATION OF GOLD-CADMIUM CRYSTALS CONTAINING 47.5 ATOMIC PERCENT CADMIUM. Lo-Ching Chang. Jan. 9, 1951. 12p. (NYO-756)

The atomic displacements and crystallographic mechanism in diffusionless transformation of Au-Cd single crystals containing 47.5 at. % Cd were investigated. The alloy transforms from an ordered body-centered cubic structure (β_1) on cooling to about 60°C to an orthorhombic structure

(β'). The reverse transformation from β' to β_1 takes place when the alloy is heated to about 80°C. The lattice parameters of both phases were determined by x-ray measurements to be: β_1, a = 3.3165 ± 0.0005 kX units (corrected to room temperature); β', a = 3.1476 ± 0.0005, b = 4.7549 ± 0.0005, c = 4.8546 ± 0.0005 kX units. Atomic displacements involved in the transformation were discussed and transformation matrices were derived. The crystallographic mechanism of the transformation was experimentally evaluated as a $(331)_{\beta_1}$ $[323]_{\beta_1}$ simple homogeneous shear of about 3 degrees ($\tan \gamma_0 = 0.05$), plus a possible contraction of the b edge of the orthorhombic cell by about 0.015 kX units. The lattice parameters of the orthorhombic phase calculated according to this crystallographic mechanism are in almost exact agreement with those directly obtained by x-ray measurement. (auth)

4694

CRYSTAL STRUCTURE OF THE COMPOUNDS LaHg, CeHg, PrHg, and NdHg. Aldo Iandelli and Riccardo Ferro. Atti accad. nazl. Lincei, Classe sci. fis., mat. e nat. (8) 10, 48-52(1951) Jan. (In Italian)

Amalgams of La, Ce, Pr, and Nd of the composition MeHg were prepared by fusing each rare earth with Hg in stoichiometric proportions at 1200°C; the easily oxidized products had to be treated under an atmosphere of CO_2. The x-ray study of the structure, made by the powder method, showed body-centered cubic lattices. A comparison of the lattice constants with the atomic radii revealed an anomalous contraction of CeHg, a phenomenon already observed in other compounds of this element (Klemm et al., Z. anorg. u. allgem. Chem. 252, 67(1943)).

DEUTERIUM AND DEUTERIUM COMPOUNDS

4695

AN APPARATUS FOR THE PRODUCTION OF PURE DEUTERIUM FROM HEAVY WATER. M. M. Winn. J. Sci. Instruments 28, 152(1951) May.

Electrolysis is used to produce the gas in a small, easily constructed apparatus. Purification is carried out by diffusion through a palladium tube. The plant uses about 10 g of electrolyte, a 10% solution of heavy sulfuric acid (D_2SO_4) in heavy water, and may be left unattended during operation. (auth)

FLUORINE AND FLUORINE COMPOUNDS

4696

Carbide and Carbon Chemicals Co., K-25

REACTIONS OF TERTIARY AMINES WITH POLYFLUOROOLEFINS; PART A. ALIPHATIC TERTIARY AMINES; PART B. AROMATIC TERTIARY AMINES. Roy L. Pruett. May 14, 1951. 106p. (K-762)

Aliphatic tertiary amines, particularly those which contain small alkyl groups, have been found to react readily at room temperature with hexafluorocyclobutene. The initial quaternary salts obtained were very reactive toward water, alcohols, and primary or secondary amines. Hydrolysis gave a series of stable compounds which, on the basis of chemical degradation, method of preparation, and spectral data are thought to be trialkyl (3,3-difluoro-2,4-dioxocyclobutyl) ammonium betaines. Part A of the report contains a detailed extensive investigation of these reactions. Formation of quaternary salts, hydrolysis and reactions of many of these products, and absorption spectra are described. Investigation of aromatic tertiary amines (Part B) showed that they react with hexafluorocyclobutene (and with polyfluoroolefins in general) at room temperature but that the nature of the products varies greatly with the type of amine. There is little similarity between the products received with aliphatic tertiary amines and those from aromatic tertiary amines. Detailed descriptions of some of the latter are given.

4697

New Hampshire Univ.

THE REACTION OF FLUORINE WITH CADMIUM AND SOME OF ITS BINARY COMPOUNDS; THE CRYSTAL STRUCTURE, DENSITY, AND MELTING POINT OF CADMIUM FLUORIDE. Helmut M. Haendler and Walter J. Bernard. June 15, 1951. 9p. (NYO-661)

The reaction of Fl with Cd, CdO, $CdCl_2$, and CdS has been investigated. CdF_2 is the only nonvolatile product formed. The crystal structure of CdF_2 has been checked, and a more precise lattice constant determined; a_0 = 5.3880 ± 0.0005 A. The reported experimental density values have been corrected; d = 6.33 ± 0.06 g/cc. The melting point of CdF_2 is 1049 ± 2°C. (auth)

4698

FLUORINE CHEMISTRY, Vol. I. J. H. Simons, ed. New York, Academic Press, 1950. 615p.

Reviews by various authors, of certain areas of fluorine chemistry are given, with emphasis on the inorganic fluorides. Some of the chapter titles are "Nonvolatile Inorganic Fluorides," "The Halogen Fluorides," "Boron Trifluoride," "Hydrogen Fluorides," "Physical Properties of Fluorine," "Fluorocarbons and Their Production."

LABORATORIES AND EQUIPMENT

4699

Mineral Engineering Lab., Mass. Inst. of Tech.

A SIMPLE RELIABLE ETHER ALARM. Donald W. Haney and John Dasher. Feb. 28, 1951. 5p. (MITG-266)

To monitor laboratory atmosphere for explosive vapors, an inexpensive ether alarm device has been built and found to perform satisfactorily. A simple filamentary-bridge ether detector with 2 sensitivity settings, the Davis Vapotester Model M-6, was converted into a continuously operating automatic relay alarm by furnishing it with a power supply and a sensitive triggering relay system and attaching it to a vacuum line. 1 diagram. 1 photograph.

4700

Geological Survey

A FLUORIMETER FOR SOLUTIONS. Mary H. Fletcher and E. Ray Warner. Apr. 1951. 14p. (TEM-252)

A description of and complete drawings for the construction of a sturdy and versatile fluorimeter for measurement of fluorescence of solutions are given. It may be used with various phototubes and measuring devices and is constructed so that phototubes and filters may be changed readily. Sensitivity is controlled easily over a wide range by limiting the size of either the ultraviolet or fluorescent light beam with standard apertures. 8 diagrams. (auth)

MOLECULAR STRUCTURE

4701

Pittsburgh Univ.

DIELECTRIC POLARIZATION STUDIES OF METALLIC CHELATES (Contribution No. 823). Robert G. Charles and Henry Freiser. Apr. 25, 1951. 5p. (NYO-735)

The dielectric polarizations of dioxane solutions of lead 8-hydroxyquinolinate and disalicylidenemethylamine Cu have been measured at 30°C. These compounds, like the acetylacetonates, are found to have abnormally high atomic polarizations. It is possible that most metallic chelates exhibit this phenomenon. The solubilities of some metallic (Pb, Cd, U, Fe, Cu, Bi) 8-hydroxyquinolinates in benzene and dioxane at 25°C have also been measured. (auth)

RADIATION EFFECTS

4702

Oak Ridge National Lab.

DECOMPOSITION OF WATER AND AQUEOUS SOLUTIONS UNDER MIXED FAST NEUTRON AND GAMMA RADIATION (Based on ORNL-130). A. O. Allen, C. J. Hochanadel, J. A. Ghormley, and T. W. Davis. Apr. 1951. 45p. (AECU-1413; CF-51-4-11)

The mechanism of reactions occurring in H_2O in aqueous solutions under high-energy radiations has been discussed in an earlier publication (Allen, J. Phys. Colloid Chem. 52, 479(1948)). Purified water, irradiated in the Oak Ridge reactor, decomposes to a limited extent only. The products (H_2, H_2O_2 and O_2) react with each other under radiation to re-form water, so that a steady-state level of products is quickly reached, which in pure water at 25°C lies at about 20 micromoles per liter of dissolved H_2. The steady-state level is very sensitive to the presence of certain kinds of dissolved material or impurities, and is consequently poorly reproducible and tends to drift upward with time because of slow contamination with impurities from the vessel walls. Addition of H_2 suppresses the decomposition, but added O_2 or H_2O_2, like many other solutes, greatly increases the decomposition. The kinetics of the reaction between dissolved H_2 and H_2O_2 were found to be reproducible when the H was in excess, and were studied in detail. Experimental details are discussed; the method of determination of pressure in the pressure-indicating silica ampules containing the H_2O samples is described.

4703

Argonne National Lab.

THE RADICAL PAIR YIELD OF IONIZING RADIATION IN AQUEOUS SOLUTIONS OF FORMIC ACID. Edwin J. Hart. May 31, 1951. 14p. (ANL-4636)

The mechanism of formic acid oxidation by Co^{60} γ rays and by β rays from tritium disintegration has been studied in aqueous solution. In aqueous solutions subjected to ionizing radiation, H and OH radicals are produced. It is found that the formic acid-O_2 reaction may be employed to measure the relative amounts of those radicals that recombine to form H_2 and H_2O_2 and of those capable of reacting with formic acid and O_2. Of these radicals, 21 and 30% undergo recombination in formic acid solutions irradiated by Co^{60} γ rays and tritium β rays, respectively. In aqueous solutions of formic acid subjected to β-ray irradiation from tritium, 29.8 ev are expended per measurable radical pair. (auth)

4704

INITIATION OF VINYL POLYMERIZATION BY MEANS OF HIGH-ENERGY ELECTRONS. John V. Schmitz and Elliott J. Lawton. Science 113, 718-19(1951) June 22.

High-energy electrons from a cathode-ray generator of the resonant transformer type, operating at 800 kvp, have been found to induce the polymerization of various monomers, including acrylates, methacrylates, styrene, and acrylonitrile. Difunctional vinyl monomers, such as tetraethyleneglycol dimethacrylate (TEGMA), polymerize much more than monomers containing only one double bond. The conversions were increased by either an increase in the dose or an increase in the length of time employed to administer the same dose. In a detailed investigation of TEGMA it was found that the minimum temperature at which polymerization occurred was between −50 and −55°C, which is also the range in which TEGMA hardens into a glassy solid. The polymerization of cross-linking monomers (e.g., TEGMA), initiated by high-energy electrons, was found to be dimensionally specific and could be used to form shaped objects in a pool of monomer. The polymerization apparently did not propagate beyond the region of ionization and radical formation.

4705

RADIATION CHEMISTRY. I. V. Vereshchinskiĭ. Uspekhi Khim. 20, 288-308(1951) May-June. (In Russian)

An outline is given of the methods of radiation chemistry and of the main results obtained in studies of chemical changes produced by radiations in water, in aqueous solutions of inorganic and organic compounds, and in biologically important substances. 89 references.

RARE EARTHS AND RARE-EARTH COMPOUNDS

4706

Ames Lab.

CONDUCTANCES OF AQUEOUS SOLUTIONS OF SOME RARE EARTH CHLORIDES AT 25°C. F. H. Spedding, P. E. Porter, and J. M. Wright. June 6, 1951. 17p. (AECU-1374)

The equivalent conductances of aqueous solutions of the chlorides of La, Ce, Pr, Nd, Sm, Eu, Er, and Yb have been measured in the concentration range 0.0004N to 0.1N. The anticipated uniform change in properties with atomic number was not found for the first four members of the series, but beyond these the behavior was as expected. This behavior may be associated with differences in the coordination numbers of the rare earth ions for water molecules. 4 figures. (auth)

4707

Wisconsin Univ.

THE SPECTRA OF CERIUM(IV) IN PERCHLORIC ACID EVIDENCE FOR POLYMERIC SPECIES. Edward L. King and Mary L. Pandow. [nd] 14p. (AECU-1518)

The spectra of Ce(IV) perchlorate in perchloric acid–sodium perchlorate solutions have been studied. It has been found that Beer's law is not obeyed in the wavelength region 440 to 530 mμ over the Ce(IV) concentration range 4×10^{-4}M to 10^{-1}M at H^+ concentrations of 0.85M and 2.57M. The spectral data are consistent with the existence in the solutions of equilibria between monomeric and dimeric species. Higher polymers may also be present. The extinction coefficient of Ce(IV) in solutions which are relatively concentrated in perchlorate ion) >6M) is much greater than in dilute solution. This is observed for both $HClO_4$ and $HClO_4$–$NaClO_4$ solutions. The system Ce(III)-Ce(IV) does not exhibit "interaction-absorption" under the concentration conditions studied. (auth)

4708

NEW INVESTIGATIONS ON METAL HYDROXIDES AND HYDROUS OXIDES. Oskar Glemser. Fortschr. chem. Forsch. 2, No. 2, 273-310(1951). (In German)

In a survey of works on metal hydroxides and hydrous oxides data on rare earths, such as disintegration temperature of hydroxides as a function of lattice-cell dimensions, are given. 114 references.

4709

THE PROBLEM OF THE REDUCTION OF SAMARIUM, NEODYMIUM, AND PRASEODYMIUM IONS ON THE DROPPING MERCURY CATHODE. V. A. Zarinskiĭ. Zhur. Fiz. Khim. 24, 662-9(1950) June. (In Russian)

In a study of the mechanism of the polarographic reduction of Sm, Nd, and Pr ions it was found, contrary to observations reported by Noddack and Bruckl (Angew. Chem. 49, 533(1936); 50, 362(1937)), that polarograms of 0.01M solutions of sulfates do not exhibit any two-step reduction processes in the absence of inert electrolytes. On the other hand, in the presence of a 0.1N LiCl solution, polarograms of the chlorides of the three rare earths point to the existence of two reduction stages, viz., a reduction, at about −1.8 v, of Me^{+3} to Me^{+2}, followed by a reduction to metallic state. It is shown furthermore, that with the aid of the polarographic method the formation of complexes between

rare earths and potassium citrate (or other organic compounds) can be conveniently studied.

SEPARATION PROCEDURES

4710

Argonne National Lab.

CHROMATOGRAPHIC SEPARATION OF C^{14} FRUCTOSE, GLUCOSE, AND SUCROSE ON A CELLULOSE COLUMN. (abstract) William Chorney and Ronald Watanabe. May 1951. 1p. (AECU-1358; UAC-388)

The report is reproduced here in its entirety.

A method has been devised whereby a mixture of fructose, glucose, and sucrose can be separated in pure form on a cellulose column. The sugars were tagged biosynthetically by allowing starved excised Canna leaves to photosynthesize in an atmosphere of $C^{14}O_2$. The sugars were extracted from the leaves with 80 per cent ethanol. After removal of the alcohol and precipitation of the protein, the solution was deionized and decolorized by passage through appropriate resin columns. The concentrated sugar solution was added to a paper column that had been thoroughly washed and subsequently equilibrated with 95 per cent butanol-water mixture. The column was developed with 95 per cent butanol. The fructose appeared first followed by glucose. After the monosaccharides were eluted, the developing solvent was changed to 50 per cent ethanol, which removed the sucrose. In preliminary studies the elution of the sugars was followed by analysis of fractions of the eluate with the Anthrone method for determination of carbohydrates. With labeled sugars, small aliquots of each fraction were plated on aluminum disks and counted. The purity of the fractions was determined by filter paper partition chromatography and subsequent spraying with appropriate developing reagents. In the case of radiosugars, the filter papers were radioautographed.

4711

Ames Lab.

PRODUCTION OF HAFNIUM CONCENTRATE BY ADSORPTION. Gerhard H. Beyer, Alfred Jacobs, and Richard D. Masteller. June 8, 1951. 12p. (AECU-1399)

A process has been developed for concentrating Hf from a naturally occurring feed material containing 2 wt. % hafnium oxide (based on Hf and Zr content) to an approximately 90 wt. % hafnium oxide in two cycles. Each cycle consists of the adsorption of Hf and zirconium tetrachlorides in methanol solution on activated silica gel, and the subsequent stripping of the gel using a methanol-hydrogen chloride strip solution and, finally, a sulfuric acid strip solution. Approximately 70% of the original Hf adsorbed can be recovered as high-Hf concentrate. 6 figures. (auth)

4712

Fordham Univ.

A STUDY OF THE EXTRACTION OF IRON WITH THENOYLTRIFLUOROACETONE AS A FUNCTION OF pH. Michael Cefola and Bruno Miccioli. June 1, 1951. 12p. (NYO-721)

Distribution ratios at 25°C of Fe^{+3} (concentration = 0.01666 mg/ml) between H_2O and thiophene-free benzene containing thenoyltrifluoroacetone (TTA) have been measured from a pH of −10 to a pH of 4.0 for 0.2M and 0.5M TTA. From these data and activity coefficient corrections, equilibrium constants for the over-all extraction in the pH range 2.1 to 2.7, where the values are fairly constant, have been calculated. The removal from an aqueous phase of approximately 99% of the Fe originally present should be possible with two extractions.

4713

Oak Ridge National Lab.

CALCULATION MANUAL FOR LIQUID-LIQUID EXTRACTION. F. P. Pike. May 31, 1951. 133p. (ORNL-929)

A calculation manual for liquid-liquid extraction processes is presented, providing the background for a consistent mathematical picture covering the rate of extraction. The basis for the treatment is the idea that diffusion is the controlling process, and that the resistances to diffusion reside in two liquid films adjacent to an interface. The analysis leads to methods of interpretation and correlation of experimental data, to procedures for equipment design, and to suggestions on the planning and conduct of experimental work. (auth)

4714

Radiation Lab., Univ. of Calif.

CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS XVII. PREPARATION AND ISOLATION OF Cr^{51} FROM VANADIUM. Jeanne D. Gile, Warren M. Garrison, and Joseph G. Hamilton. May 18, 1951. 3p. (UCRL-1316)

Report is made of the radiochemical isolation of carrier-free Cr^{51} from a vanadium target which had been bombarded with 19-Mev deuterons. The bombarded V was dissolved in HNO_3, and the Cr^{51} precipitated quantitatively with $Fe(OH)_3$ upon the addition of Fe^{+3} and NaOH. The precipitate was redissolved and precipitated several times, and finally the $Fe(OH)_3$ containing the Cr^{51} was washed and dissolved in HCl, and the Fe was extracted with ether. In a chemical separation using added Cr, V, Ti, and Sc carriers, more than 98% of the activity was recovered in the Cr fraction.

4715

ADSORPTION CURVE OF A RARE EARTH IN AN ION-EXCHANGE COLUMN. H. B. Van Der Heijde and A. H. W. Aten, Jr. J. Phys. & Colloid Chem. 55, 740-4(1951) May.

The adsorption curves of neutron-activated dysprosium ions in an exchange column were determined, both after the initial adsorption and in two different phases of elution with ammonium citrate solution. Results of the experiment are shown to be in good agreement with predictions made on theoretical grounds by Boyd et al. (J. Am. Chem. Soc. 69, 2849(1947)). The general relations between the adsorption and elution curves are discussed.

4716

PREPARATION OF Zn^{65} OF HIGH SPECIFIC ACTIVITY FROM COPPER BOMBARDED WITH 16-Mev DEUTERONS. C. J. Maletskos, E. W. Backofen and John W. Irvine, Jr. J. Chem. Phys. 19, 796(1951) June. (Letter to the editor)

Zn^{65} was prepared by the $Cu^{65}(d,2n)$ reaction using 16-Mev deuterons at the MIT cyclotron. The target consisted of sheet Cu, 0.126 in. thick, of commercial purity. The procedures of solution of the target and isolation of Zn^{65} are discussed in detail. Analyses of the Cu showed that Zn was present to the extent of 0.005%. Specific activities as high as 130 mc/mg were obtained with a 90% recovery of the original Zn^{65} activity.

4717

Atomic Energy Research Establishment, Harwell, Berks. (England)

THE PURIFICATION OF SEMIMICRO QUANTITIES OF TIN. F. Hudswell and J. S. Nairn. Jan. 1951. 13p. (AERE-C/R-650)

A method is given for the purification of small amounts of Sn (~250 mg) from Cu, Pb, Fe, and silica. The process involves the fractional distillation of stannic chloride followed by the hydrolysis of this material and the H_2 reduction of the stannic oxide obtained. The only reagents required are water, chlorine and hydrogen. The impurities are removed to individual limits of less than 1 part in 10^4. (auth)

SORPTION PHENOMENA

4718

EXCHANGE BETWEEN N_2^{30} AND N_2^{28} OVER IRON CATALYSTS. J. T. Kummer and P. H. Emmett. J. Chem. Phys. 19, 289-92(1951) Mar.

The rates of exchange between N_2^{28} and N_2^{30} obtained on doubly- and singly-promoted iron catalysts is of the right order to be accounted for by assuming that all N_2 evaporating from the surface of the catalyst is completely equilibrated with respect to the N_2 isotope exchange. Large concentrations of H_2 (50% H_2 in N_2) markedly accelerate the reaction. Small traces of surface oxides poison the iron catalysts severely for the isotope exchange. (auth)

SPECTROSCOPY

4719

Argonne National Lab.

MODIFICATIONS OF THE ABSORPTION SPECTRA OF ANIONS INDUCED BY COMPLEX FORMATION. (abstract) Leonard I. Katzin. Apr. 17, 1951. 1p. (AECU-1369; UAC-381)

The report is reproduced here in its entirety.

Since the majority of inorganic anions are colorless, and the ions of metallic elements which most readily form chemical complexes with anions are generally colored, the altered absorption spectrum produced in the visible region of the spectrum by the complex formation is usually referred to as the absorption spectrum of the complex. However, the absorption spectrum of the nitrate ion, with a characteristic peak at about 300 mμ, is altered by complexing with metal ions, and in a given case one can identify shifts of both the anion and cation absorption spectra. The type of nitrate absorption shift found is related to the electronic configuration of the metal atom. Thiocyanate ion also has an absorption in part in reach of the Beckman spectrophotometer (> 220 mμ) and in tertiary butyl alcohol medium can be shown to give a markedly shifted absorption in the presence of cobaltous or nickelous perchlorate, while the spectra in the visible region show the characteristic changes in the absorption of the metal ion.

Solid lithium chloride (and hence, presumably, chloride ion) absorbs far in the vacuum ultraviolet. Solutions of lithium chloride in tertiary butyl alcohol do not absorb appreciably above background in the region above 220 mμ, and neither does cobaltous perchlorate. In mixture, strong absorption in the region 220 to 260 mμ is apparent, in addition to the characteristic cobalt chloride blue color in the visible region. Nickelous perchlorate, in similar fashion, evokes a characteristic absorption spectrum in the same region of the ultraviolet. Bromide and iodide ions, which absorb in the ultraviolet above 220 mμ, also show spectral modifications on forming complexes and allow one to follow the changes in greater detail.

SYNTHESES

4720

Western Reserve Univ.

FORMATION OF FORMALDEHYDE FROM C^{14} GLYCEROL BY PROPIONIBACTERIUM. F. W. Leaver. [nd] 3p. (AECU-1370)

This report is reproduced here in its entirety.

It has been previously reported that following the fermentation of glycerol as well as other substrates by P. arabinosum in the presence of C^{14} formaldehyde, the isolated propionate was completely labeled, the highest activity occurring in the carboxyl position (Leaver, J. Am. Chem. Soc. 72, 5326(1950)).

Using 1-C^{14} glycerol as a substrate in a similar fermentation it has now been possible to isolate labeled formaldehyde from the medium.

Eighty micromoles of unlabeled formaldehyde and 2.4 micromoles of 1-C^{14} glycerol per 100 ml were fermented with resting cells using phosphate-bicarbonate buffer. At the end of 18 hr the formaldehyde was separated by neutral distillation. Twenty-eight micromoles were recovered as determined by the chromotropic acid method (Alexander, Landweier, and Seligman, J. Biol. Chem. 160, 51(1945)). To this, 124 micromoles of carrier formaldehyde was added and the dimedon derivative was made and found to have a constant specific activity when recrystallized from aqueous acetone and from aqueous alcohol. The specific activity was 1560 cts/min/mM of carbon or 8600 cts/min/mM carbon in the original undiluted formaldehyde obtained from the fermentation. The average activity of the 1 and 3 carbons of the added C^{14} glycerol was 13,000. Similar results have been obtained in a second experiment. Formaldehyde added to 1-C^{14} glycerol and isolated without fermentation was found to be inactive.

The propionate formed by resting cells of P. arabinosum from 1-C^{14} glycerol also has been degraded. It was separated by steam distillation, chromatographed on a silica gel column and degraded (Wood and Werkman, J. Bact. 30, 332 (1935); Biochem. J. 30, 618(1936)) (Goodwin, J. Am. Chem. Soc. 42, 39(1920)) after conversion to lactate through bromination. The distribution of activity expressed as cts/min/mM was CH_3-(4760)-CH_2-(4840)-COOH-(8100). The activity of the CO_2 and bicarbonate of the buffer was 1630. This distribution is strikingly similar to that found when C^{14} formaldehyde was fixed in the propionate (Leaver, J. Am. Chem. Soc. 72, 5326(1950)).

From the results of the above experiments it seems that formaldehyde is formed largely from the 1,3 carbons of glycerol. Whether or not the 2 carbon of glycerol can be converted to formaldehyde to some extent cannot be definitely answered at present. The demonstration that formaldehyde is produced and utilized by P. arabinosum during the fermentation of glycerol indicates that formaldehyde or some compound in equilibrium with it is an active intermediate. The mechanism of propionate fermentation is under further investigation.

4721

Harvard Medical School

A SYNTHESIS OF α- OR β-C^{14}-LABELLED GLYCEROL. L. I. Gides and M. L. Karnovsky. [nd] 13p. (AECU-1515)

Reaction schemes which have been adopted for selectively labeling glycerol in either the α or β position with C^{14} and methods for determining the purity and specific activity of the product are presented.

4722

Radiation Lab., Univ. of California

THE PREPARATION OF C^{14}-LABELED BENADRYL, PYRIBENZAMINE AND 1,1-DIPHENYL-4-DIMETHYL-AMINOBUTENE-1. T. A. Geissman. Apr. 11, 1951. 16p. (UCRL-1233)

A detailed description is given of the preparation of C^{14}-labeled antihistamines Benadryl and Pyribenzamine, and of structurally related (to Benadryl) 1,1-diphenyl-4-dimethylaminobutene-1, which is devoid of antihistaminic activity and was included to serve as a control in future studies of specific antihistaminic effects. All were isolated as the hydrochloride salts. In the cases of both Benadryl and Pyribenzamine the residual amines recovered from recrystallization mother liquors were used for the preparation of the corresponding methiodides. Activity measurements

of the final compounds were carried out by direct plating of the hydrochlorides, from aqueous solution, onto glass or Al planchets.

4723

Radiation Lab., Univ. of California

1-NAPHTHALENEACETIC-α-C^{14} ACID. Patricia T. Adams and David Kritchevsky. May 1, 1951. 5p. (UCRL-1262)

Naphthaleneacetic acid, labeled in the methylene group with isotopic carbon, was synthesized. The general scheme involved carbonation of 1-naphthylmagnesium bromide with radioactive carbon dioxide and reduction to the carbinol with Li-Al hydride. The carbinol was not isolated but treated directly with gaseous hydrogen bromide to give 1-bromomethyl-C^{14}-naphthalene. The halide was treated with K cyanide and the nitrile thus obtained was hydrolyzed to give 1-naphthaleneacetic-α-C^{14} acid. The yield of purified acid was 35% from carbon dioxide.

4724

Radiation Lab., Univ. of California

THE REACTION OF PHENYLAMIDOCHLOROPHOSPHATES WITH ARYL GRIGNARD REAGENTS. D. C. Morrison. May 9, 1951. 7p. (UCRL-1288)

The reaction was studied as a possible approach to the synthesis of aromatic phosphonic acids, $ArPO(OH)_2$, from $POCl_3$ as starting material. The object of the preparations was to obtain the phosphonic acids in radioactive form from $POCl_3$ containing P^{32}. Using the dianilido chlorophosphate as an intermediate, and reaction with arylmagnesium bromides, mediocre yields of aryl phosphonic dianilides were obtained apparently according to the equation $(C_6H_5NH)_2POCl + ArMgX \rightarrow ArPO(NHC_6H_5)_2 + MgXCl$. An analogous reaction, the action of aryl Grignards on monoanilido chlorophosphate, $C_6H_5NHPOCl_2$, forms very little of the desired product formed by Cl replacement, the phosphinic monoanilides $Ar_2PONHC_6H_5$. The secondary dianilido chlorophosphate reacts more satisfactorily with the reagent, but in some cases yields are poor. The experimental procedures are discussed for preparation of benzenephosphonic acid dianilide, hydrolysis of p-tolyl phosphonic dianilide, preparation of diphenyl phosphinic anilide, and hydrolysis of diphenyl phosphinic anilide.

4725

THE PREPARATION AND PROPERTIES OF TETRAKISTRICHLOROPHOSPHINE NICKEL. John W. Irvine, Jr. and Geoffrey Wilkinson. Science 113, 742-3(1951) June 29.

Preparation of tetrakistrichlorophosphine nickel, $Ni(PCl_3)_4$, by direct action in the liquid phase of PCl_3 on $Ni(CO)_4$ is described. Detailed information is given on the chemical, crystallization, and magnetic susceptibility properties of the compound. Related reactions, such as that of $Ni(CO)_4$ with PBr_3, and preparation of $Ni(PBr_3)_4$ are reviewed.

4726

THE SYNTHESIS OF CHOLINE (METHYL-C^{14}) CHLORIDE CONTAINING METHYL-C^{14}. Arthur Roe. J. Elisha Mitchell Sci. Soc. 67, 54-5(1951) June.

With the method described for synthesis of choline, yields of 95 to 98% of choline chloride based on methyl iodide were realized.

TRACER APPLICATIONS

4727

Brookhaven National Lab.

THE REACTION OF NITROUS ACID WITH HYDROXYLAMINE. A. Bothner-By and L. Friedman. [nd] 13p. (AECU-1359)

Approximately equal quantities of $N^{14}N^{15}O^{16}$ and $N^{15}N^{14}O^{16}$ are produced by reaction of hydroxylamine hydrochloride and N^{15}-enriched sodium nitrite in solution in O^{18}-enriched water. The same reaction when carried out in a solution brought to a pH of 1 with gaseous HCl produces an excess of $N^{14}N^{15}O^{16}$. In both experiments the concentration of $N^{15}N^{15}O^{16}$ was accounted for on the basis of the reaction of nitrous acid with hydroxylamine to yield nitrous oxide molecules containing one nitrogen atom from each source. O^{18} exchange occurred to a greater extent in acid medium and the double tagged N_2O so produced was mainly $N^{15}N^{15}O^{18}$ rather than a mixture of the isomers $N^{14}N^{15}O^{18} + N^{15}N^{14}O^{18}$. These observations lead to the following conclusions concerning the reaction mechanisms. In neutral solution most of the nitrous oxide produced is formed by dehydration of a symmetrical intermediate, probably hyponitrous acid. In acid medium a competitive dehydration of an unsymmetrical intermediate plays an important role. Mechanisms involving nitroxyl as an intermediate are untenable. Oxygen exchange is acid catalyzed and occurs exclusively with nitrous acid or with an unsymmetrical intermediate formed in the course of this reaction. Oxygen atoms from either nitrous acid or hydroxylamine appear in the product nitrous oxide. (auth)

URANIUM AND URANIUM COMPOUNDS

4728

EFFECT OF WATER OF CRYSTALLIZATION ON THE FLUORESCENCE SPECTRUM OF URANYL NITRATE. PART I. A. N. Sevchenko, V. M. Vdovenko, and T. V. Kovaleva. Zhur. Eksptl'. i Teoret. Fiz. 21, 204-11(1951) Feb. (In Russian)

Observations were made on the fluorescence of uranyl nitrates containing 6, 3, 2, and 1 molecules of water of crystallization, as well as of the anhydrous salt. A summary of the results is given in Part II, Zhur. Eksptl'. i Teoret. Fiz. 21, 212(1951).

4729

EFFECT OF WATER OF CRYSTALLIZATION ON THE FLUORESCENCE SPECTRUM OF URANYL NITRATE. PART II. A. N. Sevchenko and B. I. Stepanov. Zhur. Eksptl'. i Teoret. Fiz. 21, 212-19(1951) Feb. (In Russian)

Part I of this work appeared in Zhur. Eksptl'. i Teoret. Fiz. 21, 204(1951). Changes in the number of molecules of water of crystallization in uranyl nitrates are accompanied by considerable changes in the frequency both of the symmetrical valency oscillations of the UO_2^{++} ion in the lattice and of the electronic transitions. The fine structure of the spectrum, as observed at low temperature, is determined essentially by transitions between energy levels of the crystal lattice, only a few lines being due to transitions between electronic-oscillation levels of the uranyl ion. (auth)

4730

Atomic Energy Research Establishment

Harwell, Berks. (England)

THE MAGNETIC SUSCEPTIBILITY AND ELECTRONIC STRUCTURE OF THE URANOUS ION IN SOLID SOLUTIONS OF URANIUM TETRAFLUORIDE AND THORIUM TETRAFLUORIDE. J. K. Dawson. May 4, 1951. 9p. (AERE-C/R-709)

The magnetic susceptibilities of solid solutions of UF_4 and ThF_4 have been measured over the temperature range 90 to 350°K, and at all dilutions the susceptibility of the U(IV) ion obeys the Weiss-Curie law. At infinite dilution the extrapolated susceptibility and the magnetic moment of U(IV) are close to the theoretical values predicted for a $5f^2$ electron configuration with the j-j type of coupling. This is in contrast to the corresponding oxide system in which urania is diluted with thoria, since the susceptibility and the magnetic moment of U(IV) at infinite dilution in that

case correspond to theoretical values expected for a $6d^2$ electron configuration. (auth)

4731

ON THE COMPLEX CHEMISTRY OF THE URANYL ION. IV. THE COMPLEXITY OF URANYL ACETATE. Sten Ahrland. Acta Chem. Scand. 5, 199-219(1951). See NSA 3-2163, 4-1421, 4-3955 for parts I, II and III.

Provided the complexity is sufficiently strong, complex solutions are not very much influenced by hydrolysis even at pH values where the central group is strongly hydrolyzed. This suggests a way of determining the complexity of such systems which cannot be measured at very low pH. It is, however, necessary to test the applicability of the method in every case by measuring at various pH levels. This proceeding also enables an extrapolation to strongly acid solutions in the case of a slight influence of pH. The method has been applied to the system of uranyl acetate, where it functions well. Both electromotive force and extinction measurements were performed, with consistent results Three complexes were proved between the central group M, in this case $(UO_2)^{++}$, and a ligand A, viz., MA_1, MA_2, MA_3, the last one being the saturated complex of the system. Their constants are, at the existing conditions: $\beta_1 = 240C^{-1}$; $\beta_2 = 2.3 \times 10^4C^{-2}$; $\beta_3 = 2.2 \times 10^6C^{-3}$, where C is the unit of concentration, 1 mol/liter. The statement that MA_3 is a saturated complex is, however, founded merely on the electromotive force measurements. 9 tables. (auth)

ENGINEERING

4732

Knolls Atomic Power Lab.

BENDING OF PERFORATED PLATES. G. Horvay. [nd] 4p. (AECU-1480)

In disagreement with Malkin (ASME Annual Meeting, 1950, Paper No. 50-A-120) who has shown that a tube sheet of triangular layout can be treated in bending calculations as an isotropic homogeneous plate of effective Poisson's ratio, $\mu = (1 - K)/(3 + K)$, and Young's modulus, $E' = (1 - \mu')(h/R)E$, the author has derived the equivalent constants of the plate to be $\mu' = (1 - K)/(3K + 1)$ and $E' = (1 - \mu')(h/R)E$.

HEAT TRANSFER AND FLUID FLOW

4733

Knolls Atomic Power Lab.

TRANSIENT THERMAL STRESSES IN CIRCULAR DISKS. G. Horvay. [nd] 31p. (AECU-1481)

An appraisal has been made of the temperature transient and stress transient experienced by a circular disk when subjected to an edge temperature. The stresses and distortions produced when a steady temperature distribution is maintained in a circular disk have been evaluated, and the problem of determining the transient in a solid disk because of the applied edge temperature has been investigated.

4734

Knolls Atomic Power Lab.

STRESSES IN PERFORATED SHEETS DUE TO NONUNIFORM HEATING. G. Horvay. May 1951. 17p. (AECU-1494)

Theoretical concepts of the behavior of perforated sheets of triangular layout with regard to temperature distribution are discussed in some detail. Methods are shown for the calculation of stresses in perforated sheets caused by arbitrary temperature distributions.

4735

Knolls Atomic Power Lab.

SODIUM; A NONCORROSIVE COOLANT. R. F. Koenig and S. R. Vandenberg. [nd] 17p. (AECU-1495)

A general description of the corrosive properties of Na is presented, and several corrosion tests are described. Examples of five types of attack on containers by liquid metals are mentioned. The steps followed in making a static corrosion test are discussed, and descriptions of four types of dynamic tests are included, namely, rotating specimen (whirligig), thermally circulated loops (harps), forced-circulation loops, and surveillance coupons in operating heat-transfer systems. Four methods of determining the effect of Na immersion on mechanical properties of construction materials are outlined. Eight forms of test apparatus are illustrated by photographs or diagrams.

4736

Carbide and Carbon Chemicals Co., K-25

GASEOUS SELF-DIFFUSION AND FLOW IN CAPILLARIES AT LOW PRESSURES. Sidney Visner. May 9, 1951. 159p. (K-688)

Through the use of a radioactive tracer, Xe^{131} grown from I^{131}, an experimental investigation of the self-diffusion and specific flow of xenon in capillaries was carried out at low pressures. The transport of the tracer from one chamber to another through a capillary was determined by directly measuring the relative concentration of the tracer in each chamber with end-window counters. Capillaries of 0.0025 and 0.025 cm radius and half-length to radius ratio, L/r, of 66, 9.8, and 2.8 were used over a pressure range of 0.003 to 15.8 mm Hg, corresponding to radius to mean free path ratios, r/λ, of 0.001 to 65. For the longest capillaries, the dependence of the self-diffusion coefficients on r/λ agrees with the Pollard-Present theory. For the tube of medium length, L/r = 9.8, the theory predicts an approximate value 9% higher than was found experimentally at low pressures; while for the shorter tube L/r = 2.8, it is not possible to estimate the diffusion coefficients from the theory. For all L/r ratios in the limit of zero pressure, the specific flow coefficients coincide, as expected, with the self-diffusion coefficients and agree with the Clausing theory, which is only applicable at this limit. The self-diffusion coefficient for xenon extrapolated to 76 cm Hg pressure is 0.0576 ± 0.0009 cm^2/sec at 27.3°C, which is in agreement with high-pressure diffusion theory. 13 tables. 21 figures. (auth)

4737

Radiation Lab., Univ. of California

USE OF THE UNSTEADY STATE METHOD FOR THE DETERMINATION OF THE THERMAL CONDUCTIVITY OF GASES. Alexander L. Lindsay and LeRoy A. Bromley. Feb. 1951. 49p. (UCRL-1128)

An unsteady state method is described in which a charge of electricity is passed through a stainless steel tube containing a gas to raise the temperature abruptly a fraction of a degree. The change in the pressure (or volume) due to temperature change of the gas is followed with time. From the resulting data, it is possible to calculate the thermal

diffusivity and thence the thermal conductivity of the gas. This method has been applied to numerous gas mixtures, and the results obtained are in substantial agreement with published measured values. The results agree well with the equation of the authors (Ind. Eng. Chem. 42, 1508-11(1950)) for gas mixtures. 3 tables, 14 figures. (auth)

VACUUM SYSTEMS

4738

GLASS VALVES FOR VACUUM CONTROL. J. Franklin Inst. 251, 643-4(1951) June.

A glass-seal type of valve which operates at pressures of the order of 10^{-6} mm Hg has been developed for accurate control of gas flow into or through the system. Expansion of glass or metal when heated is utilized to break a glass seal which separates the vacuum system from another of higher pressure. When the source of heat is removed, contraction of the glass reseals the system. The valve makes possible a continuously variable control of the rate at which gas can be admitted to an evacuated system. Initial measurements indicate that leakage through the valve into a 1-liter volume will raise the gas pressure by as little as several tenths of a micron in 1 hr. On the basis of this information, another application for this device would be as a calibrated leak for a mass-spectrometer leak detector.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

4739

Alfred Univ.

FUNDAMENTAL PROPERTIES OF METAL-CERAMIC MIXTURES AT HIGH TEMPERATURES; PERIOD STATUS REPORT No. 26; PROGRESS DURING PERIOD APRIL 1 TO MAY 31, 1951. W. B. Crandall, Director. May 31, 1951. 15p. (NP-3115)

An investigation of the change in slope in the temperature vs. oxide layer penetration curve of a Co-Al_2O_3 system showed that the rate of change of oxygen concentration in the pores of the specimen is controlled by the rate at which oxygen diffuses into the specimen and the rate at which oxygen is removed from the pores by metallic oxidation. Gaseous diffusion constants increase with temperature and porosity, metallic oxidation constants increase with temperature, and cermet oxidation is a function of the difference of these two constants. The oxide layer maximum is shown to shift to the left and be slightly lower with decreasing porosity. A program to study the effect of porosity on weight gain in the Co-Al_2O_3 system showed an increase in rate of weight gain with increase in porosity, a discontinuity present in the weight gain vs. porosity relationship at about 5% porosity, and an increase in metal concentration decreasing the weight gain for these porosities. An investigation to determine the feasibility of preparing hot-pressed specimens of Ti-C for elevated temperature tensile-strength testing showed this to be the method of choice for forming specimens to exact dimensions. X-ray-diffraction data for a number of oxide-metalloid-intermetallic mixtures show that borides are very reactive at high temperatures, that silicon nitride reacts more readily than TiN with MgO and Al_2O_3, that silicon carbide is unreactive in these mixtures, that many mixtures with ZrC are unstable in water, and that the aluminides, in decreasing order of reactivity, are Ni-Al, Cr-Al, and Mo-Al.

GEOLOGY AND GEOPHYSICS

4740

DATING LATE-PLEISTOCENE EVENTS BY MEANS OF RADIOCARBON. Richard Foster Flint. Nature 167, 833-6 (1951) May 26.

A brief review of the origin and nature of C^{14}, the method of assay of samples, and possible errors in the use of C^{14} for geological dating is given. General results so far obtained are listed, and the dating of specific events, namely, Two Creeks horizon, Allerød horizon, Pine-Pollen zone in Eastern United States, glacial Great Lakes, Mt. Mazama, Folsom Man, and Lascaux Cavern, is discussed more fully.

METALS AND METALLURGY

4741

Ames Lab.

ELECTRICAL PROPERTIES OF SODIUM WOLFRAM BRONZE. E. J. Huibregtse, D. B. Barker, and G. C. Danielson. May 23, 1951. 13p. (AECU-1379)

With the addition of Na atoms the ferroelectric insulator WO_3 acquires metallic properties. Single crystals of Na_x-WO_3 were grown by combining $3Na_2WO_4$ with $2WO_3$ and W. Chemical analyses for Na concentration showed $x = 0.66$. The electrical resistivity was found to have a value of $(1.9 \pm 0.2) \times 10^{-4}$ ohm-cm at 0°C and to decrease approximately linearly with decreasing temperature in the range 20 to −160°C. The Hall coefficient was found to have a value of $(-5.1 \pm 0.2) \times 10^{-4}$ cm³/coulomb at 20°C and to decrease slightly with decreasing temperature. This value for the Hall coefficient indicates one electron carrier for each Na atom added to the crystal. The magnetic susceptibility calculated agrees well with an experimental value for Na concentration corresponding to $x = 0.9$ (Stubbin and Mellor, J. Proc. Roy. Soc. N.S. Wales 82, 225(1948)). Electron mobility and mean free path, energy at the surface of the Fermi distribution, thermal conductivity, and electronic specific heat are calculated.

4742

Armour Research Foundation

PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS; MARCH 1 - MAY 1, 1951. (Report No. 2). Donald J. McPherson and M. Hansen. May 14, 1951. 26p. (COO-30)

Progress of work on annealing treatments, micrographic analysis and melting studies of Zr-Cu, Zr-Sn, and Zr-Mo alloys is reported. A high-temperature vacuum induction furnace for determination of melting temperatures is described, and diagrams and photographs showing the design and operating procedures, as well as results of melting runs on Zr and Zr alloys, are included.

4743

Armour Research Foundation

PHASE DIAGRAMS OF ZIRCONIUM-BASE BINARY ALLOYS; MAY 1 - JULY 1, 1951 (Report No. 3). Donald J. McPherson and M. Hansen. July 10, 1951. 32p. (COO-31)

Experimental trials have revealed a melting technique for Zr-W alloys which appears to completely eliminate unmelted W. Microstructural analysis of heat-treated alloys

has yielded a good outline of the Zr-Sn system in the 0 to 46% Sn range. The balance of this system, unsuitable to normal heat treating techniques because of free Sn in the structures, is being investigated by special techniques. The systems of Zr with Mo, Cu, Cr, Si, and Al have been surveyed by the examination of as-cast alloys. The phases present and the general phase relationships in each of these systems are outlined. The pretreatment steps involving homogenization and cold work have been initiated on Zr-rich alloys of the Zr-Si and Zr-Al systems.

4744

Dow Chemical Co.

ROOM AND ELEVATED TEMPERATURE PROPERTIES OF POWDER EXTRUDED MAGNESIUM ALLOYS CONTAINING ALUMINUM, BERYLLIUM AND ZIRCONIUM; QUARTERLY STATUS REPORT; NOVEMBER 1, 1950 - FEBRUARY 1, 1951 (Report No. 15263). T. E. Leontis. Feb. 6, 1951. 17p. (COO-42)

Tension tests at temperatures up to 600°F on all KO + A33 extruded mixtures have been completed. Up to 300°F, addition of A33 to KO produces an increase in strength with increasing amount of added A33. At higher temperatures, however, there is no significant effect from such additions. Introduction of the Al into KO either as elemental Al or in the form of Mg-Al alloys more dilute than A33, produces essentially the same properties as A33. Although heat treatment of the KO powder at 1050°F prior to extrusion is detrimental to the room temperature properties of KO + A33 mixtures, the elevated temperature strength properties of these mixtures are enhanced by such a heat-treatment applied to the KO prior to extrusion. The room-temperature creep resistance of extruded KO mixtures containing Al or Mg-Al alloys are increased substantially, in many cases more than doubled, by heat-treatment at 750°F subsequent to extrusion. In general, the creep resistance of these alloys at room temperature increases as the dilution in Al of the Mg-Al component increases.

4745

Dow Chemical Co.

PREPARATION OF HIGH PURITY MAGNESIUM AND A STUDY OF THE EFFECT OF NON-METALLIC AND ALKALI METAL IMPURITIES ON THE CORROSION CHARACTERISTICS OF PURE MAGNESIUM; 6TH QUARTERLY REPORT; MARCH 1, 1951 - MAY 31, 1951. [nd] 30p. (COO-47)

In the production of high-purity Mg as free as possible of both metallic and nonmetallic impurities, as well as in the evaluation of the corrosion characteristics of this metal, a number of melts of pure Mg were made with additions of the following impurities: Mg_2C_3, grease, Li, Ba, Sr, K, Na, Ca, Si, Mn, and Fe. Of all these contaminants only Fe and Ca showed definitely detrimental effects (in the concentration range studied) as evaluated by alternate immersion in 3% NaCl. The corrosion results of carbide contamination were erratic and are still inconclusive. The tolerance limit for Fe in Mg is observed at 0.008% rather than 0.016 as previously reported by Hanawalt et al. This difference is attributed to the increased accuracy of the spectrographic analysis for Fe as currently practiced. A maximum in the corrosion rate curve is also observed at the critical Fe concentration of 115 to 270 ppm. Mg has been produced free of MgO in the sublimation-vacuum casting unit as evaluated by electron-diffraction analyses.

4746

Knolls Atomic Power Lab.

DISLOCATION COLLISION AND THE YIELD POINT OF IRON. A. N. Holden. May 1951. 34p. (Memo-ANH-2)

A mechanism for the yield point of Fe is presented that is based on the release of an avalanche of dislocations by the collision of moving dislocations with others anchored by solute atoms. A mean free path between collisions is calculated for the probable density of dislocations in an annealed crystal, and the absence of a yield point in an annealed crystal is predicted. Yield points are predicted to occur in single crystals after strain aging. A specimen size effect in the magnitude of the yield point of strain-aged crystals is also predicted. All the predictions are supported by experiment. 19 references. (auth)

4747

Massachusetts Inst. of Tech.

SOLID SOLUTIONS AND GRAIN BOUNDARIES; TECHNICAL PROGRESS REPORT NO. 5, SCOPE II. B. L. Averbach, L. Seigle, and M. Cohen. Apr. 1950. 10p. (NYO-577)

The present report continues the description of the experimental work now being carried out to measure thermodynamic activities in solid Ni-Au alloys. These alloys separate into two phases at low temperatures, and in this case large positive deviations from ideal behavior are to be expected. The apparatus described in Progress Report No. 4 was used with electrodes of pure Ni and Ni-Au alloys containing 10 and 15 at. % Au. The electrolyte was a eutectic mixture of KCl + LiCl containing 1 mole % of $NiCl_2$. The cell was heated in an atmosphere of purified A. The preliminary run was carried out in the temperature range 700 to 800°C, by heating the cell to temperatures within this range and holding at temperature for several hours. Results are summarized. A value of 400 cal/mole for the partial molal heat of solution of Ni and a value for the partial molal entropy of mixing of Ni of 0.460 were obtained. Although there is yet no assurance that the emf values are reproducible, and the thermodynamic data for the 12 at. % Au alloy reported are very uncertain, the results offer some basis for optimism about the experimental method. The observed positive deviation from Raoult's law, and positive heat of solution agree qualitatively with predicted behavior for Ni-Au alloys.

4748

Massachusetts Inst. of Tech.

FUNDAMENTALS OF COLD WORKING AND RECRYSTALLIZATION; TECHNICAL PROGRESS REPORT NO. 1, SCOPE III; 1 JULY 1950 - 30 SEPTEMBER 1950. B. L. Averbach and M. Cohen. [nd] 3p. (NYO-856)

A new x-ray technique has been developed which is capable of determining the average atomic displacements in each of the important crystallographic directions of a deformed crystal. This procedure involves the precise measurement of the intensity distribution in powder-pattern-diffraction lines and a corresponding interpretation in terms of atomic displacements. It is also possible to obtain further information describing the average distribution of atomic strains within the crystal. The powder-pattern technique has been applied to the study of recovery and recrystallization in the case of alpha brass filings. The atomic displacements are now being analyzed and the results will be available soon. Single crystals of Cu, Cu-2% silicon alloy, Al, and α brass have been grown.

4749

Carnegie Inst. of Tech.

DIFFUSION IN GRAIN BOUNDARIES AND THEIR STRUCTURE. M. R. Achter and R. Smoluchowski. [nd] 18p. (NYO-992)

The rate of intergranular diffusion of Ag in Cu is shown to be strongly influenced by the relative orientation of the grains. The variation of the diffusion rate indicates a greater degree of disorder in grain boundaries with greater orientation difference. An interpretation of the diffusion data is given in terms of a grain boundary model which correlates the dislocation model applicable at low angles of

misfit with the "island" model applicable at large angles of misfit. This interpretation is also in agreement with the dependence of grain boundary energy on the angle of misfit. (auth)

4750

Sylvania Electric Products, Inc.

THE PHYSICAL PROPERTIES OF SINTERED ZIRCONIUM. Herbert S. Kalish, Henry H. Hausner, and Roswell P. Angier. Mar. 30, 1951. 36p. (SEP-44)

It is shown that Zr is a most suitable metal for powder metallurgical application, and that the use of Zr hydride powder in the fabrication techniques has many advantages over the use of Zr powder. The pressing and sintering conditions for producing Zr by powder metallurgy were established. Both types of powder were found to compact easily and to sinter at a fairly low temperature to the theoretical density of Zr. Covered graphite boats were used during sintering. When sintered at 1150 to 1250°C in vacuum, Zr hydride powder decomposes to metallic Zr, and this formation of the metal during an earlier stage of sintering results in a high activation of the particles, which permits sintering to the theoretical density in fairly short times and at low temperatures. The properties of sintered Zr were investigated. The studies included the ultimate density of sintered Zr as a function of compacting pressure, a correlation of grain growth with densification, and the factors affecting hardness and resistivity of the sintered product. Sintered Zr was found to have good ductility. (auth)

4751

THE ELECTROLYTIC POLISHING AND ETCHING OF URANIUM. B. W. Mott and H. R. Haines. Metallurgia 43, 255-7(1951) May.

Experiments have been conducted with many solutions for electrolytic polishing of U. The apparatus used and composition of the four electrolytes selected as having a useful application are discussed. The one found to be most satisfactory is orthophosphoric acid, 50 ml; concentrated sulfuric acid, 100 ml; and distilled water, 100 ml. Polishing is carried out with this solution at an optimum current density in the range 0.5 to 0.75 amp/cm^2. The polished surface obtained is generally very flat, and the tendency to pit is far less than with any other solution investigated so far. Due to the increase in the uniformity of the surface, the reaction to polarized light is more satisfactory than with specimens polished in other solutions. Only one solution has been found to be reasonably reliable for etching for microscopical examination, and it reveals only the more marked differences in orientation. The composition of several electrolytes which were found to be useful for macroetching are given.

4752

THE FIVE PROPERTIES CONCERNED IN THE TRANSPORT OF THE ACTIVE CORRODENT AGENT. R. C. L. Bosworth. J. Proc. Roy. Soc. N. S. Wales 84, 53-8(1950).

Corrosion of a metal by a corrodent liquid which attacks the surface uniformly is controlled by five physical properties: (a) the maximum rate, (b) a conductance term, (c) a compliance term, (d) an inertial term, and (e) the electrochemical driving force. All five factors may be determined by methods outlined in previous papers (Bosworth, J. Proc. Roy. Soc. N. S. Wales 83, 25, 124(1949)). The rate of corrosion of a specimen freshly placed in a corrodent is expected to show transient phenomena, and where the contribution of the inertial element may be neglected the time constant for such transients is roughly proportional to the square of the depth of immersion of the specimen.

4753

GROWTH OF MOLYBDENUM SINGLE CRYSTALS. N. K. Chen, R. Maddin, and R. B. Pond. J. Metals (N.Y.) 3, 461-4 (1951) June.

A modified Andrade furnace, by means of which large single crystals of Mo or any refractory metal can be rapidly grown, is described in detail. With the present arrangement, material of rather large size, i.e., ½-in. rod, can be converted into single crystalline form. Experiments have demonstrated that single crystals approximately 1½ in. long can be produced in a total of 7 hr. A very sharp temperature gradient exists in the specimen, and no observable difference in the results could be noted when an external furnace was added.

4754

THE HEAT TREATMENT OF ALUMINIUM ALLOYS. J. Crowther. Metallurgia 43, 243-7(1951) May.

The mechanism of precipitation hardening in an Al-Cu alloy is described. Four commercial Al alloys (Duralumin B, S, H, and K) are discussed, especially with regard to the different heat-treatments employed. Five graphs illustrate the effects of various heat-treatments and the progress of precipitation hardening.

4755

INTERCRYSTALLINE CORROSION OF ALLOYS. G. V. Akimov. Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 13-25(1951) Jan-Feb. (In Russian)

Intercrystalline corrosion, which plays an important part in the deterioration of mechanical properties of alloys, is investigated in the light of the theory of polyelectrode systems. A new microelectrochemical method is described for the construction of cathode polarization curves for alloy surfaces with insulated and noninsulated boundaries between crystals. It is found that the intercrystalline corrosion of stainless steel containing 27% Cr is due to the feeble anode polarization of the boundaries; this is probably caused by the formation, during the tempering from a high temperature, of a phase poor in Cr between the crystals. Practical measures against intercrystalline corrosion are suggested.

4756

Institute of Engineering Research, Univ. of Calif.

INVESTIGATIONS ON THE MECHANISM OF THE STRAIN INDUCED MARTENSITIC REACTION IN 18-8 STAINLESS STEEL (Fifteenth Technical Report, Series 22, Issue 15) C. Dean Starr, M. Reporter, and J. E. Dorn. June 15, 1951. 58p. (NP-3206)

An analytic formulation of the shear mechanism of martensite formation is developed. The analytic theory and deformation studies indicate that some of the details of the Cohen postulates for martensite formation require modification. In particular it appears to be highly improbable that embryos are produced by thermal fluctuations at the annealing temperature and are then frozen in situ upon quenching. It is more likely that small shear strain embryos are produced by thermal fluctuations. Due to the anisotropic nature of these preembryonic regions, high stresses are introduced during cooling which generate active embryonic regions. It has been shown that no unique plastic critical point exists. The effect of flow stress and plastic strain on the martensite reaction have been investigated. Stress appears to have a minor effect in inducing the reaction to occur. The effect of strain appears to induce higher shear strain energy embryos. (auth)

4757

ON THE VOLUME DIFFUSION OF METALS. G. J. Dienes. J. Applied Phys. 22, 848-9(1951) June. (Letter to the editor)

Recent data on diffusion of Sn in Sn, Co in Co, and Au in Cu of Fensham (Australian J. Sci. Research A3, 91-104 (1950); A3, 105-8(1950)), Nix and Jaumot (Phys. Rev. 82, 72(1951)), and Martin and Asaro (Phys. Rev. 80, 123(1950)) are tabulated and analyzed. These points fit very well on the correlation curve previously proposed by the author (J. Applied Phys. 21, 1189-92(1950)). The self-diffusion for tin especially is more readily explained by the author's correlation scheme than by the proposal of Zener that a negative entropy of activation implies short-circulating paths for diffusion (J. Applied Phys. 22, 372(1951)).

4758

PHYSICS AND METALLURGY; trans. from Metallurgia 4, 171-8(1950). G. Masing. 1950. 26p. (NP-2310)

The application of physical techniques to the field of metallurgy is discussed. The works of various investigators which have contributed to modern metallurgy theory are considered. 17 references.

4759

THE PRODUCTION AND DETECTION OF A NON-EQUILIBRIUM NUMBER OF VACANCIES IN A METAL. A. S. Nowick. Phys. Rev. 82, 551-2(1951) May 15. (Letter to the editor)

Experiments are described which give fairly direct evidence that diffusion in close-packed metals occurs predominantly through the movement of vacancies. If such is the case it should be possible to quench a nonequilibrium number of vacancies into a specimen; the presence of the excess of vacancies may be detected by the effect they have in lowering the relaxation time of the specimen at any given temperature. Such effects have been found. The alloys used were α solid solutions of Ag-Zn.

4760

RECOVERY AND RECRYSTALLIZATION IN HIGHLY STRESSED PURE ALUMINIUM. E. A. Owen and Y. H. Liu. Proc. Phys. Soc. (London) 64 B, 386-96(1951) May.

An account is given of an x-ray study of the phenomena observed when polycrystalline pure Al is subjected to heavy compressional stresses. The rate of recovery to the metastable state under various conditions has been examined in some detail. During recovery recrystallization occurs; the crystals grow rapidly at first, but afterward the rate of growth decreases until finally, after the metastable state has been reached, there are no further changes in crystal sizes. The recovery phenomenon and recrystallization are two different processes but they are not independent of each other. Crystals grow when the value of the stress varies from point to point in the material; when the stresses become evenly distributed, as is found to be the case in the metastable state, the crystals stop growing. The change from the state immediately following plastic deformation to the equilibrium crystalline state takes place in two stages, one brought about by strain energy and the other by thermal energy. The results are considered in the light of the dislocation theory. (auth)

4761

Office of Naval Intelligence

RELAXATION AT HIGH TEMPERATURES; trans. from Czechoslovakian paper. Alexander A. Chitkov. Oct. 3, 1950. 22p. (ONI-A-446)

The phenomena of creep and relaxation in metal at high temperatures has been considered. A mathematical correlation is made between the relaxation and creep in the instance of screw connection of metal parts. The extent of validity of the two hypotheses ("theory of strain-hardening" and "theory of time-hardening") by Davenport (J. Applied Mechanics 55A, (1938)) on the process of creep and relaxation has been studied. The processes of relaxation have been considered and relaxation curves set up. Distinction has been made between relaxation and creep. 17 references.

4762

General Electric Co.

A SECONDARY RECRYSTALLIZATION TEXTURE IN COPPER (Report No. 50TP120). M. Sharp and C. G. Dunn. June 5, 1951. 17p. (NP-3220)

A report is made of the texture obtained by the secondary recrystallization of OFHC Cu which was cold-rolled 90% prior to annealing. The texture consists of a number of preferred orientations each of which, except for twins, has been related to the primary recrystallization texture by a rotation about a ⟨100⟩ or a ⟨111⟩ axis. 10 figures. (auth)

4763

Battelle Memorial Inst.

TECHNICAL NOTE ON A SENSITIVE METHOD FOR THERMAL ANALYSIS OF VERY LOW MELTING ALLOYS. R. M. Evans, E. O. Fromm and R. I. Jaffee. June 1, 1951. 14p. (BMI-RIJ-3)

A method for the thermal analysis of very low-melting alloys has been developed. As used, the method was suitable for work in the temperature range −72 to 250°C. However, it is suggested that with suitable adjustment the method could be adapted for use over broader temperature ranges. The Rosenhain temperature gradient furnace (J. Inst. Metals, 13, 160(1915)), adapted for low-temperature use, was the basis for the method. The gradient was set up in a stainless-steel tube. The specimens were lowered through it at a constant rate while time-temperature or inverse rate data were taken. Details of the furnace and the specimen holder are shown diagrammatically. Thermal analysis curves were obtained with the furnace described. Typical curves for Ga-rich alloys are shown.

4764

THE THERMODYNAMIC PROPERTIES OF GASEOUS TITANIUM. Paul W. Gilles and Quentin de L. Wheatley. J. Chem. Phys. 19, 129-30(1951) Jan. (Letter to the editor)

The thermodynamic properties of gaseous Ti have been calculated using the energy levels given in Natl. Bur. Standards (U.S.) Circ. 467, 273-7(1949). The methods of calculation were those of Giauque (J. Am. Chem. Soc. 52, 4808 (1930)). Results are tabulated. A graph of the calculated heat capacity vs. temperature shows a maximum of 6.578 cal/deg mole at 135°K and a minimum of 5.096 cal/deg mole at 990°K, followed by a steady increase with temperature to the highest temperature investigated.

MINERALS AND MINERALOGY

4765

Division of Raw Materials, AEC

SELECTED BIBLIOGRAPHY OF PUBLISHED REFERENCES ON URANIUM OCCURRENCES AND RADIOACTIVE ORE DEPOSITS OF POSSIBLE INTEREST TO THE PETROLEUM INDUSTRY. Margaret Cooper, comp. Mar. 1951. 15p. (RMO-547)

This is a selected but not exhaustive listing of published literature on types of U occurrences and ore deposits and on radioactivity in petroleum, kolm, shales, and related carbonaceous deposits. It is described as a preliminary sampling of the published literature to serve as a guide and source of background information for petroleum geologists and the petroleum industry. (137 references)

PHYSICS

4766
Knolls Atomic Power Lab.
AN EXPERIMENT ON THE RISE OF LIQUID SODIUM IN CAPILLARY GROOVES. R. L. Cummerow and J. H. Read. Apr. 24, 1951. 31p. (KAPL-508)

Results of experiments on the rise of Na in vertical grooves on an unoxidized stainless-steel rod in a He atmosphere at 300 to 600°C are correlated with theory. The capillary rise is shown to be amenable to exact analysis. The dependence of the behavior of the liquid on small irregularities in the groove profile is demonstrated. The theory and experiment presented provide a first step for approximate and semiempirical descriptions of liquids on machined and ground surfaces.

4767
INTERPRETATION OF NUCLEAR QUADRUPOLE COUPLINGS IN MOLECULES. Walter Gordy. J. Chem. Phys. 19, 792-3(1951) June. (Letter to the editor)

From examination of nuclear quadrupole couplings in a number of molecules, Townes and Dailey (J. Chem. Phys. 17, 782(1949)) have assigned 18% s character to the bonding orbital of Cl in ICl, CH_3Cl, and ClCN, and pure p-bonding orbitals to Br and I in similar molecules. Upon reexamination of these cases with the more recent coupling data on other molecules, the author has found that it is possible to obtain a self-consistent interpretation of the couplings by assuming pure p-bonding orbitals for Cl, Br, and I, except when they are combined with the first-period elements C and F. These couplings yield new values of the nuclear quadrupole moments of the Br and I isotopes as follows: Br^{79}, 0.31×10^{-24} cm²; Br^{81}, 0.26×10^{-24} cm²; I^{127}, -0.65 10^{-24} cm²; I^{129}, -0.47×10^{-24} cm².

4768
THE PURE QUADRUPOLE SPECTRUM OF SOLID CHLORINE. Ralph Livingston. J. Chem. Phys. 19, 803(1951) June.

This report is reprinted in its entirety.

The pure quadrupole spectrum of solid chlorine at liquid N temperature has been measured in the manner previously described (R. Livingston, Phys. Rev. 81, 289(1951)). A single line was observed for Cl^{35} at 54.248 Mc. The Cl^{37} line was also seen at the expected frequency. The approximate nuclear quadrupole coupling for Cl^{35}, spin ½, in solid Cl then is 108.5 Mc, twice the observed frequency. The sign of the coupling is not determined by this method but it should be negative. The corresponding coupling for atomic Cl, which lacks one p electron from having a closed shell, is −110.4 Mc. Townes and Dailey (J. Chem. Phys. 17, 783 (1949)) have pointed out that covalently bonded Cl compounds should have a coupling approximately equal to that of the free atom if the Cl bond is a pure p type. Since molecular Cl should have little if any ionic character it appears that the bond in the molecule uses essentially a p orbital with no, or very little, s hybridization.

COSMIC RADIATION

4769
COSMIC RADIATION AND COSMIC MAGNETIC FIELDS. I. ORIGIN AND PROPAGATION OF COSMIC RAYS IN OUR GALAXY. A. Unsöld. Phys. Rev. 82, 857-63(1951) June 15.

The radiofrequency radiation of the galaxy is shown to be analogous not to the "quiet" but to the "disturbed" radiation of the sun (produced by plasma oscillations). Many arguments point toward its origin on stars with an "activity" qualitatively similar to that of the sun but several billion times stronger. It is assumed that in these stars the relation between radiofrequency radiation and the emission of cosmic rays is similar to that observed for the sun by Forbush (Phys. Rev. 70, 771(1946)) and Ehmert (Z. Naturforsch. 3a, 264(1948)). In the magnetic field of the galaxy this primary cosmic radiation is "stored" by a factor of 10^3 to 10^4, each particle describing a complicated path until it is killed by a nuclear collision, and directional isotropy established. The cutoff of the energy spectrum at small energies, hitherto mostly ascribed to a solar magnetic dipole, is attributed to the stopping power of interstellar matter. Some other theories concerning the origin of cosmic rays are reviewed critically. (auth)

4770
COSMIC RADIATION AND COSMIC MAGNETIC FIELDS. II. ORIGIN OF COSMIC MAGNETIC FIELDS. Ludwig Biermann and Arnulf Schluter. Phys. Rev. 82, 863-8(1951) June 15.

The equations governing the behavior of a wholly or partly ionized gas moving in the presence of a magnetic field are given. It is emphasized that the electric conductivity is independent of the magnetic field strength in many cases of actual interest. The stationary case of a magnetic field arising from the nonrigid rotation of a gaseous body is considered. Such a field is of the toroidal type. Fields of poloidal type may arise by the contraction of magnetized interstellar matter toward a star. The increase of strength of a magnetic field in turbulent conducting matter (stellar or interstellar) is considered. The conclusion is reached that the turbulence of every order of magnitude leads finally to a magnetic field, the energy density of which corresponds roughly to the energy density of the turbulence considered. If the magnetic field was weak in the beginning, this state was reached at first by the turbulence of smallest scale and smallest velocity, and then by the turbulence of higher orders; hence, the magnetic field strength must change secularly, as long as this process goes on. If our galaxy had only weak fields in its earlier stages, the present magnetic field should correspond to the turbulent velocity associated with distances of the order of 10^3 light years (between 10^{-6} and 10^{-5} gauss), and these fields should be more or less homogeneous over distances of this order. If there were already fields in the beginning, the present fields might be somewhat stronger. (auth)

4771
COSMIC RAYS. Louis Leprince-Ringuet. New York, Prentice-Hall, Inc., 1950. 290p.

This translation from the original French describes the way cosmic-ray research is carried out on the continent of Europe, especially by the French. Pictures of the laboratories and plates of observations on cosmic-ray phenomena are included. The second half of the book discusses the present status of our knowledge of cosmic radiation. A more complete review may be found in Nucleonics 8, No. 6, 38-9(1951) June.

4772
DETECTION OF μ MESONS AND OTHER FAST CHARGED PARTICLES IN COSMIC RADIATION, BY THE ČERENKOV EFFECT IN DISTILLED WATER. J. V. Jelley. Proc. Phys. Soc. (London) 64A, 82-7(1951) Jan.

The Cherenkov effect has been established for the passage of cosmic-ray μ mesons through distilled water. The light pulses were observed using a photomultiplier and fast amplifier; the experiments were carried out using the detector alone, and in a coincidence-telescope arrangement. The

ratio of the light emitted in the downward and upward directions was measured as a function of discriminator bias. In addition measurements were carried out at various depths of water and with various orientations of the detector with respect to the vertical. Estimates of the absolute efficiency were made and other characteristics of the detector are discussed. (auth)

4773

OBSERVATION OF COSMIC RAY EVENTS IN NUCLEAR EMULSIONS EXPOSED IN A GLACIER AT 3550 m. J. B. Harding. Phil. Mag. 42, 651-62(1951) June.

Photographic emulsions have been exposed at various depths under ice at 3550 m. The variation in the numbers of slow μ mesons with depth is in fair agreement with a predicted variation. From the variation of the numbers of "stars" with depth, the best estimate for the absorption mean free path of the star producing radiation is 170 ± 10 g/cm^2. The variation of the numbers of π^+ mesons with depth is consistent with an absorption path length for nuclear interaction corresponding to a few times the geometric value. A large upward stream of π mesons has been observed and possible interpretations are discussed. (auth)

4774

OBSERVATIONS OF SLOW MESONS AND NUCLEAR DISINTEGRATIONS IN PHOTOGRAPHIC PLATES EXPOSED UNDER CARBON ABSORBERS. J. C. Barton, E. P. George, and A. C. Jason. Proc. Phys. Soc. (London) 64A, 175-93(1951) Feb.

The exposure was made at the Jungfraujoch, altitude 3,457 m, using Ilford type C2 nuclear research emulsions. The frequency of stars under thicknesses of C up to 220 gm/cm^2 was measured, the experimental value of the absorption length of the radiation causing them being 166 ± 8 gm/cm^2. The proportion of the stars due to fast π mesons has been evaluated and, on subtracting this proportion, the absorption length of the radiation responsible for the remainder is found to be 143 ± 10 gm/cm^2. The energy distribution of the stars having 3 to 20 tracks is found to be of the form $dE/E^{2.6}$, with no apparent discontinuity. The frequencies of slow π and μ mesons at various depths is reported. The π mesons exhibit a transition effect which is interpreted in terms of their production in stars occurring in the C absorber. The ratio of negative to positive π mesons is found to be 3.1 to 1. (auth)

4775

RATE OF PRODUCTION OF NEUTRONS IN ICE BY COSMIC RAYS. S. Lattimore. Phil. Mag. (7) 42, 331-7 (1951) Apr.

The rate of production in ice of fast neutrons is given. It is shown that the number of fast neutrons produced at any point in the ice is approximately proportional to the number of cosmic-ray stars at that point. The results are compared with those of other investigations, and it is pointed out that many previous results are too low due to the misuse of a formula given by Bethe et al. (Phys. Rev. 57, 573(1940)).

4776

RATIO OF NEGATIVE TO POSITIVE π-MESONS IN THE STRATOSPHERE. W. F. Fry. Phys. Rev. 82, 747(1951) June 1. (Letter to the editor)

Single stacks of 12 electron-sensitive NTB-3 plates were exposed in the stratosphere by means of meteorological balloons at altitudes near 60,000 ft. A total of 118 meson stars and 41 $\pi-\mu$ decays were found, along with 500 mesons which stopped in the emulsion without associated particles other than electrons. Studies by other workers on the percentage of positive and negative π mesons which decay, stop, or produce stars in emulsions are discussed and utilized in computing the ratio of negative to positive low-energy π mesons as 3.2 ± 0.7. Nearly all the π mesons which stopped in the emulsions must have been generated with a kinetic energy in the interval 6 to 50 Mev. The excess of negative π mesons indicates that a large portion of the low-energy mesons (6 Mev < E < 50 Mev) are produced at these altitudes by neutrons.

ELECTRONS

4777

ON THE ENERGY LOSS OF FAST ELECTRONS IN THIN LAYERS. O. Blunck and S. Leisegang. Z. Physik 128, 500-5(1950) Nov. 16. (In German)

Values for the half width of the probability-distribution curve of energy losses of fast electrons in thin layers of matter, as provided by the theories of Williams (Proc. Roy. Soc. (London) 125, 420(1929)) and of Landau (J. Phys. U.S.S.R. 8, 201(1944)), are too small in comparison with the measured ones. These discrepancies can be removed by taking into account the effect of the quantum-theory resonance levels on the width of the distribution curves. (auth)

4778

ON THE SELF-ENERGY OF THE ELECTRON. V. P. Silin. Zhur. Eksptl'. i Teoret. Fiz. 21, 466-72(1951) Mar. (In Russian)

It is shown that gravitational effects may prove unimportant in the general problem of the self-energy of the electron. A calculation of the interaction between an electron and a meson field may show that in the domain of high energies this interaction influences the expression for the electron's self-energy in a much higher degree than does the gravitational field.

GASES

4779

COMPRESSIBILITY OF GASES AT PRESSURES UP TO 50 ATMOSPHERES. VI. CARBON TETRAFLUORIDE IN THE TEMPERATURE RANGE 0° −400°C. VI. SULFUR HEXAFLUORIDE IN THE TEMPERATURE RANGE 0° −250°C. K. E. MacCormack and W. G. Schneider. J. Chem. Phys. 19, 845-8(1951) July.

The gaseous compressibilities of carbon tetrafluoride in the temperature range 0 to 400°C, and sulfur hexafluoride in the temperature range 0 to 250°C have been measured at pressures up to 50 atm by a method employing gas expansion. The data have been fitted to a series equation of the type, PV(Amagat units) = $A_T + B_TP + C_TP^2 + D_TP^4$, and the virial coefficients are tabulated. (auth)

4780

EFFECT OF PRESSURE ON THERMAL DIFFUSION IN GASES. E. W. Becker. J. Chem. Phys. 19, 131-2(1951) Jan. (Letter to the editor)

The thermal diffusion factor α of a gas mixture is not independent of pressure as predicted by the Enskog-Chapman theory of quasi-ideal gases. A graph is presented which illustrates the empirical pressure dependence of α for A, H_2, CO_2, N_2, and CH_4. Theoretically, it has been shown that an essential part of the pressure dependence of α is due to the reality of the gases and may be described in terms of the equation of state (Becker and Schulzeff, Naturwissenschaften 35, 218(1948); Haase, Z. Physik 127, 1(1950)). The special effects observed by Drickamer et al. (J. Chem. Phys. 16, 122(1948)) in a thermal diffusion column working with CO_2/C_2H_6 may also be due to the reality of gases.

4781

ON THE VISCOSITY OF GASEOUS He^3. Otto Halpern. Phys. Rev. 82, 561(1951) May 15. (Letter to the editor)

The discovery of He^3 has offered an opportunity to study the effect of the similarity of particles on their gas-kinetic

properties. The nuclear spin of He^3 is shown to raise the viscosity of He^3 with respect to He^4 very appreciably.

4782

THE STABILITY OF GASEOUS DIATOMIC OXIDES. Leo Brewer and Donald F. Mastick. J. Chem. Phys. 19, 834-43(1951) July.

The instabilities of FeO, NiO, MnO, and SiO_2 upon vaporization, and upper limits to the heats of dissociation of these oxides and SiO have been determined by effusion experiments. The data available in the literature have been treated to obtain the heats of dissociation, or the upper limits thereof, of the gaseous oxides SnO, ZnO, CdO, CuO, PbO, GeO, and TiO. The linear Birge-Sponer extrapolation of vibrational levels appears to give correct dissociation energies for the fourth-group oxides. (auth)

INSTRUMENTS

4783

Wisconsin Univ.

A DIRECT-READING AND DIFFERENTIAL FREQUENCY METER FOR HIGH FREQUENCY TITRATIONS. W. J. Blaedel and H. V. Malmstadt. [nd] 30p. (AECU-1526)

A detailed description is made of a direct-reading frequency meter with sufficient sensitivity and linearity for use in high frequency titrations. This instrument is so designed that the output from the direct reading meter can be differentiated, giving directly a response which is proportional to the time rate of change of frequency. The instrument can be used in carrying out high frequency titrations differentially. It is also anticipated that the instrument may be of use in the determination of substances by measurement of the rate at which they react with standard substances under controlled conditions. The basic circuit is a simple RC differentiator using a high-grade polystyrene condenser of relatively low capacitance in series with a rather large resistance. The condenser in the RC network has an insignificant leakage current and "soaking effect." The time constant is low enough so there is no lag between the input and the differentiated response great enough to be significant in titrations. (auth)

4784

Los Alamos Scientific Lab.

STRAIN GAGE. John Buchen and Verner Rexroth. July 25, 1950. 23p. (LA-1266)

The SG-1 Strain Gage is a twelve-channel system capable of measuring and recording strains as small as 5 μ in./in. and as large as 40,000 μ in./in. at twelve different points on a sample under test. A permanent record of test data is recorded on a 12-point strip-chart Brown recorder. The system is essentially a wheatstone bridge whose elements are resistance strain gages. The strain gage is cemented to the material under test and is put under the same strains as the test member. When the strain gage is under tension its resistance increases and is interpreted and recorded as strain in the tested material.

4785

A MECHANICAL KICK-SORTER (PULSE SIZE ANALYZER). S. G. F. Frank, O. R. Frisch, and G. G. Scarrott. Phil. Mag. 42, 603-11(1951) June.

This instrument serves to obtain the size distribution of electric pulses coming, for example, from an ion chamber or counter. Each pulse causes a small steel ball to be propelled along an inclined board; the ball describes a parabolic path and lands in one of 30 parallel grooves. As balls accumulate in the grooves a histogram of the pulse size distribution is built up. The paper describes the mechanical construction and the associated electronic circuits. The latter serve, among other things, to eliminate pulses which are either too large or too small to be recorded, or which follow too close upon the last recorded pulse. (auth)

4786

Cryogenic Lab., Ohio State Univ.

TEMPERATURE REGULATION IN INDUCTION HEATING. (Technical Report No. 10) Homer E. Henschen, James W. Edwards, and Herrick L. Johnston. Apr. 16, 1951. 8p. (NP-3161)

Report is made of an improvement in the design of a temperature regulator for induction heating (Speiser et al., Rev. Sci. Instruments 20, 385(1949)). The improved design eliminates the optical lever by use of vacuum tube amplifiers. The result is to improve sensitivity and eliminate the large time constant of the galvanometer used in the earlier circuit. In experiments on vapor pressure of Fe and Co at 1200 to 1500°K, the new regulator held temperatures of the Fe or Co samples constant to within about 0.1% of the absolute temperature. (auth)

ISOTOPES

4787

ABUNDANCE OF N^{15} IN THE NITROGEN PRESENT IN CRUDE OIL AND COAL. Paul V. Smith, Jr., and Boyd E. Hudson, Jr. Science 113, 577(1951) May 18.

A recent paper by White and Yagoda (Science 111, 307 (1950)), disclosed an apparent correlation between the concentration of the N^{15} isotope and the geological age of the pitchblende ores. The authors investigated the possibility that this same phenomenon might apply to the chemically bound N found in crude oils and coals, but they found that the percentage abundance of N^{15} in the N obtained from the organic matter in the oil and coal is essentially the same as found in the atmosphere today.

4788

ADVANCES IN RADIOCHEMISTRY AND IN THE METHODS OF PRODUCING RADIOELEMENTS BY NEUTRON IRRADIATION. Engelbert Broda. New York, Cambridge University Press, 1950. 152p.

A review appeared in J. Franklin Inst. 251, 659-60(1951) June and is reproduced here in part.

Facts concerning the production and properties of radioactive isotopes are presented. By stating only the heart of each investigation along with its reference and omitting extraneous commentary, the author has provided a primary reference source for the phases covered, which deal mainly with work done since 1936. The application of radioisotopes as tracers is not considered, nor is the effect of radiation on molecules. The principal subjects covered include, however, the basic considerations involved in the use of radiotracers. The production of radioelements by nuclear synthesis is outlined and referenced, especially with respect to pile methods. This is followed by a brief chapter, "The Chemical Aspects of Nuclear Fission." A section of the book discusses the new radioelements, such as the transuranic, and their chemical properties. The remainder of the book is devoted to specific radiochemical effects such as the Szilard-Chalmers, and to a summary of techniques involved in making radiochemical measurements.

4789

PREPARATION OF RADIOACTIVE ISOTOPES. D. A. de Vries. Chem. Weekblad 47, 255-9(1951). (In Dutch)

An introductory description of the preparation of radioactive isotopes with the aid of the cyclotron and the uranium fission reactor is given.

ISOTOPES SEPARATION

4790

Oak Ridge National Lab., Y-12 Area

ELECTROMAGNETICALLY ENRICHED ISOTOPES; IN-

VENTORY JULY 31, 1951. C. P. Keim, C. E. Normand, and Boyd Weaver. July 1951. 65p. (Y-790)

4791

EFFECT OF TURBULENCE IN THERMAL DIFFUSION COLUMNS. John Donaldson and W. W. Watson. Phys. Rev. 82, 909-13(1951) June 15.

A certain amount of controlled turbulence improves markedly the separation factor and transport of thermal diffusion isotope separation columns. Measurements on this effect are reported for hot-wire columns 3 m long, operating on argon gas, and with power input about 725 w. At pressures three times that for onset of general turbulence the separation factor q_e is still 1.5. Spacers made of pairs of cross-wires of 40-mil Ni wire attached to the hot wire every 10 cm along its length raise the separation factor q_e for optimum pressure 9.1 to 27.2. If these spacers are attached every 5 cm, q_e rises further to 36. The optimum pressure increases creases from 0.17 atm (no spacers) to 0.28 atm. Identical operation of a similar column with a plain hot wire but with slight constrictions every 15 cm in the cold wall gives q_e = 26.6. Introduction of these regularly spaced interruptions to the lamellar convective flow of the gas also increases the transport of the A^{36} isotope to the top of the column. Some analysis of these effects is given. (auth)

4792

THERMODYNAMIC EFFICIENCY OF DEVICES FOR CONTINUOUS SEPARATION OF ISOTOPES. Gerhard Dickel. Z. physik. Chem. 197, 197-227(1951) June. (In German)

The very low efficiency of all present-day separation methods is due both to mechanical losses and to irreversible processes concomitant with the separation procedure. A calculation is made of these latter thermodynamic losses. A general formula is derived for the thermodynamic efficiency of separation methods based on diffusion and exchange processes. Applied to the special cases of thermodiffusion and pressure diffusion, this formula reveals a well-defined maximum in the efficiency curves, which depends on the dimensions of the apparatus. A comparison with experimental data, while confirming the basic results of the calculation, shows that the efficiency of existing methods is 100 times as low as the maximum attainable according to the theory. (auth)

MASS SPECTROSCOPY

4793

Institute for the Study of Rate Processes, Univ. of Utah

THE MASS SPECTRA OF LARGE MOLECULES; I. SATURATED HYDROCARBONS (Technical Report No. 1). Merrill B. Wallenstein, Austin L. Wahrhaftig, and Henry Eyring. June 15, 1951. 84p. (AECU-1484)

The operation of the mass spectrometer is discussed as affording an opportunity to study the effect of single electron impacts upon single molecules. The interpretation of the experimental results is complicated by the fact that no direct information is to be had with regard to the nature of the neutral fragments formed in the decomposition process. Reaction of monatomic and diatomic gases in the mass spectrometer are discussed. The energetics of ionization and dissociation processes as applied to hydrocarbons is investigated, and the breakdown mechanism of propane is analyzed in detail. The limited data available for larger molecules than propane indicate that other analyses could be carried out with equal success for butane, and possibly pentane, but for larger molecules it appears that a complication would arise in the form of fairly large amounts of double ionization. The examination of the mass spectra of hydrocarbon molecules larger than propane shows that the fragment ions are formed with little or no excess kinetic energy and that the mass spectrum of a given molecule is less closely related to the configuration of the carbon skeleton of the molecule (in the case of hydrocarbons) than to the bond energies of the several bonds in the molecule. These facts imply that the breakdown process is essentially thermal in character. The heats of activation for the processes producing an ion at its appearance potential, calculated from appearance potential data, combined with reasonable assumptions regarding the entropy of activation, allow free energies of activation to be assigned to each of the reactions. These free energies of activation are consistent with the observed abundances of the ions in the mass spectrum of propane.

4794

Oak Ridge National Lab., Y-12 Area

IONIZATION AND DISSOCIATION STUDIES BY MEANS OF A MASS SPECTROMETER. John R. Sites and Russell Baldock. Apr. 30, 1951. 17p. (Y-754)

Studies have been made with an 8-in. radius, 60° mass spectrometer of the ionization and dissociation properties of several compounds with vapor pressures which are suitable for stable isotope separation by means of the calutron. These studies stress the relative abundance of the singly charged metal ion in the mass cracking pattern of a particular compound. The appearance potential curves for $TiCl_4$ are shown, and mass cracking patterns are shown for $TiCl_4$, $SiCl_4$, $ZrCl_4$, $HfCl_4$, $SmCl_3$, $TeCl_4$, $VOCl_3$, VOF_3, $MoCl_5$, MoO_3, WCl_6, $W(CO)_6$, and TlCl. This use of the small mass spectrometer for quick and reliable evaluation of source materials for the large calutron has been confirmed, and several exploratory runs for stable isotope separation have been eliminated on the basis of these predictions.

4795

Oak Ridge National Lab., Y-12 Area

A VERSATILE ALL-METAL 60° MASS SPECTROMETER. Russell Baldock and John R. Sites. Apr. 23, 1951. 13p. (Y-755)

The instrument described is a variation of the well-known 60° sector-type mass spectrometer. Details of the vacuum system, ion source, detector equipment, magnetic field, and control devices are included. Novel features include overhead mounting of the magnet and use of an amplidyne generator to establish the analyzing magnetic field. (auth)

4796

RADIOFREQUENCY MASS SPECTROMETER. Paul Schissel. J. Applied Phys. 22, 680(1951) May. (Letter to editor)

A radiofrequency mass spectrometer is proposed which would utilize the natural period of ions in a parabolic potential distribution. Resolution of the spectrometer would be $(2j-1)\pi V_0/2E$, where j = an integer, V_0 = d-c supply voltage, and E = peak value of the oscillation voltage.

MATHEMATICS

4797

Kenyon Coll.

A STUDY OF CONVEX SETS IN ABSTRACT LINEAR SPACES WHERE NO TOPOLOGY IS SUPPOSED. II. W. D. Berg and O. M. Nikodým. [nd] 16p. (AECU-1529)

A purely geometrical proof of the hyperflat of support theorem is indicated, and the Hahn-Banach extension theorem for linear functionals is derived therefrom. An example is given of two linearly closed (and linearly bounded) convex bodies such that their convex hull is not linearly closed. Another example is given of two linearly bounded convex bodies whose convex hull is not linearly bounded. This example is constructed by a new method

which may be called "hilbertization" of an abstract linear space. (auth)

MEASURING INSTRUMENTS AND TECHNIQUES

4798

Wisconsin Univ.

SPHERICAL ELECTROSTATIC ANALYZER FOR MEASUREMENT OF NUCLEAR REACTION ENERGIES. C. P. Browne, D. S. Craig, and R. M. Williamson. [nd] 75p. (AECU-1348)

For accurate measurements of nuclear reaction energies a spherical electrostatic analyzer has been constructed to fit over the Wisconsin cylindrical analyzer and to accept particles at an angle of 135° from the bombarding beam. Only a portion of the entire sphere is used. This is 90° along the path of the particles with a 60° azimuthal opening. The mean radius of the gap is 18 in. and the gap spacing is $\frac{3}{16}$ in. One-million-volt protons may be focused with a gap voltage of 20.2 kv. Alignment, focus, and resolution tests show that the machining of the plates has been done satisfactorily and that the analyzer is properly aligned. A shutter allows small sectors of the total gap to be tested individually. A sharp focus is obtained and all sectors focus particles of the same energy for a given gap voltage. Resolution tests and calibration are made using monoenergetic protons scattered from thin targets of heavy elements. A plot of the number of particles entering the detector vs. the voltage across the spherical gap gives the resolution. With 1-mm object and image apertures the measured energy resolution is 600. The measured effective solid angle with this source size and resolution is 3.2×10^{-3} steradians. 21 figures. (auth)

4799

Northwestern Univ.

NEUTRON ENERGY MEASUREMENTS WITH PHOTOGRAPHIC PLATES LOADED WITH ENRICHED LITHIUM-SIX. (Progress Report No. 1) James H. Roberts. Oct. 1, 1950. 27p. (AECU-1381)

Further work on processing of Ilford C2 plates loaded with Li^6 is reported; no significant improvement over work of Keepin (UCRL-790) has been found. Range-energy calibration for the loaded C2 plates is obtained for neutrons between thermal energy and 1.5 Mev; excellent agreement with Ilford range-energy curves is obtained if Q = 4.78 Mev for $Li^6(n,\alpha)H^3$. The excited state in Be^7 at about 430 kev is confirmed by this technique using neutrons from $Li^7(p,n)Be^7$. The resolution possible for neutrons of "isotropic" incidence is studied, and it appears that nearly as good resolution as for collimated neutrons is obtained at 200 and 400 kev. It appears worse at higher energies, but this may partly result from observer bias. Angular distribution measurements for the $Li^6(n,\alpha)H^3$ reaction are being made at neutron energies of 280 and 600 kev. The data for 280-kev neutrons have been analyzed and shows strong asymmetries in the center-of-mass system. The triton yield appears to be highest in the forward direction, and there is a strong dip for the 90° position. The epithermal neutron background is quite large, so the data are under careful scrutiny before the distribution curve will be published. The data at 600 kev are not yet analyzed. (auth)

4800

Washington Univ., St. Louis. School of Medicine

A SCINTILLATION COUNTER FOR THE DIAGNOSIS AND LOCALIZATION OF INTRACRANIAL NEOPLASMS. Michel Ter-Pogossian, William B. Ittner III, William B. Seaman, and Henry G. Schwartz. [nd] 16p. (AECU-1509)

After a brief review of the use of radioactive substances for localization of brain tumors, the authors describe a scintillation counter especially designed for this purpose. The crystal used is a single clear NaI(Tl) crystal of cylindrical shape, 4 cm in diameter and 1 cm high. It is protected from air by a thin coating of "Plexiglas" and is firmly held by means of a foam-rubber cushion against the photocathode of an RCA 5819 photomultiplier tube which is protected against outside magnetic fields by a "Mumetal" magnetic shield. The detector head is suspended on a counterbalanced arm which is articulated to allow easy positioning of the detector in any position on the head of the patient, and a series of magnetic clutches are placed on the articulations of the supporting arm and energized through a switch placed near the detector head to allow the operator to "lock" the detector in any desired position. A block diagram of the electronic components is shown, and the technique for use of the counter is discussed briefly. An efficiency of ~200 times that of the conventional thin-window G-M counter has reduced the time required for brain-tumor localization to 20 or 30 min and has reduced the amount of radioactive material required by a factor of 4.

4801

Oak Ridge National Lab.

CENTER OF DETECTION CALCULATIONS FOR NEUTRON COUNTERS AND ION CHAMBERS. H. E. Hungerford, Jr. May 14, 1951. 53p. (CF-51-5-177)

Formulas are developed for finding the center of detection of various types of counters used for measuring neutrons and γ rays in a highly attenuating medium. The centers of detection of the various instruments are then calculated using the formulas developed. Results of an experiment to determine experimentally the fraction of thermal neutrons that enter a counter in a forward direction, over and above those entering more or less isotropically from all directions, are reported.

4802

Los Alamos Scientific Lab.

THE RESPONSE OF FILM TO X-RADIATION OF ENERGY UP TO 10 MEV. Ellery Storm. Mar. 22, 1951. 31p. (LA-1220)

The response of Eastman type K and DuPont 552 film to high-energy x rays was investigated. Both types of film were found to be energy independent from 0.4 to 2.0 Mev. For a given roentgen (r) value, a greater response in terms of density is obtained on the film as the effective energy is increased beyond 2.0 Mev. A method of determining the effective energy by means of filters on the film is described. (auth)

4803

Case Inst. of Tech., Western Reserve Univ.

A PROGRAM IN RADIOBIOLOGY TO BE CARRIED OUT WITH A 30-MEV BETATRON. E. C. Gregg, Jr., J. S. Krohmer, and H. L. Friedell. May 28, 1951. 21p. (NYO-1628)

A program in radiobiology is outlined to supply information on the relative contributions of the various physical and chemical processes involved in the passage of high-energy radiation through matter. Since degradation of the incident radiation is involved, the program is first concerned with the means and physical instrumentation necessary to measure such degradation in a homogeneous medium and then uses a biological detector for correlation with the determined physical parameters. Betatron-produced γ radiation, no longer monochromatic, is discussed. Instruments to be used in experimental determination of γ-ray degradation, a water phantom and ionization-chamber probe and circuit, with a special floating guard electrode, for depth dose measurement, a cavity ionization chamber for absolute beam-intensity measurements, and conditions suitable for biological measurements are discussed. A vacuum donut

for the betatron, allowing a rapid change from γ to electron radiation, is shown.

4804

AN ACCURATE LOGARITHMIC COUNTING-RATE METER COVERING A WIDE RANGE. E. H. Cooke-Yarborough and E. W. Pulsford. Proc. Inst. Elec. Engrs. 98(II), 196-203 (1951) Apr.

The paper describes an instrument whose output voltage is proportional to the logarithm of the rate at which the input pulses are received. This relationship can be made to hold, to a good approximation, over a range of pulse rates of from 1 to 10^5 pulses per second without range switching. The causes of inaccuracy and instability are examined, and it is shown that errors may be expected to be less than 10% of the pulse rate throughout the range of a five-decade instrument; the errors are correspondingly smaller in an instrument covering a smaller range. The paper shows how the instrument may be used in the investigation of some problems in nuclear physics.

4805

BEHAVIOR OF SPACE CHARGE FREE DIAMOND CRYSTAL COUNTERS UNDER BETA-RAY BOMBARDMENT. A. G. Chynoweth. Phys. Rev. 83, 264-8(1951) July 15.

By using the technique described in the preceding paper a study is made of the behavior of a diamond crystal counter under space charge free conditions when subjected to bombardment by beta-rays. The pulse heights caused by the beta-particles are found to be proportional to the energy of the beta-particles over the range 0.66 Mev to 1.0 Mev when a low field strength is used. The trap density in the crystal is found to be of the order of 2×10^{16} per cc and the mean energy required to form an electron hole pair is approximately 7 ev. (auth)

4806

THE CASCADED BINARY COUNTER WITH FEEDBACK. G. Franklin Montgomery J. Applied Phys. 22, 780-2 (1951) June.

The count of a cascade of binary pulse counters having any arrangement of feedback connections can be calculated. The calculation is simplified for two special connection patterns. For a particular count, one or the other of these patterns, or a modification of the two, requires a least number of connections. (auth)

4807

A COUNTING-RATE METER OF HIGH ACCURACY. E. H. Cooke-Yarborough and E. W. Pulsford. Proc. Inst. Elec. Engrs. 98(II), 191-5(1951) Apr.

The paper describes a counting-rate meter with which high accuracy and good linearity are obtained by virtue of the circuit design, which makes the reading very nearly independent of valve characteristics. The causes of errors are analyzed, and it is concluded that no individual source is likely to contribute an error of more than 1%. Tests indicate that an over-all stability better than ±1% is obtained in practice.

4808

DETECTION OF SLOW NEUTRONS. R. Hofstadter, J. A. McIntyre, H. Roderick, and H. I. West, Jr. Phys. Rev. 82, 749(1951) June 1. (Letter to the editor)

Single crystals of LiI(Tl) have been grown (Hofstadter, Nucleonics 6, No. 5, 70(1950)) and examined as neutron detectors. The uniformity of the neutron pulses and their relatively large size indicate that most other radiations can be screened out when desirable. By assuming that the light-pulse size is proportional to energy whatever the particle responsible for the energy loss may be, one obtains a value of 4.1 Mev for the neutron pulse heights. This agrees fairly well with the predicted energy release of 4.785 Mev due to the α-particle and triton release from Li after thermal-neutron capture. The efficiency of the LiI(Tl) counter is very high and could be made still higher with enriched Li^6. The decay constant is ~1.2 μsec, thus permitting coincidence experiments with scintillation detectors for neutrons.

4809

THE DEVELOPMENT OF END-WINDOW GEIGER-MÜLLER COUNTER TUBES. R. O. Jenkins. Proc. Inst. Elec. Engrs. 98(II), 231-6(1951) Apr.

The paper gives an account of the various stages in the development of end-window self-quenching G-M counter tubes for the detection of β-particles.

Commencing as a tube using the feather-edge type of copper-to-glass seal, 1 in. in diameter, with a copper-foil end window, the design was later modified to one more suitable for production on a larger scale, employing a standard Kovar-glass eyelet seal, the assembly of all metallic joints being effected by means of soft solder.

To permit the detection of slower β-particles, a similar tube was developed having a Duralumin window of thickness 1 mil, which was soldered to an electroplated copper layer. The assembly process was subsequently simplified by use of a thermosetting plastic adhesive wax called "Araldite."

For the detection of very slow β-particles it was necessary to use a mica window of about 0.25-mil thickness, and a suitable seal, using Araldite, was devised for windows of this material.

It was found during the course of development that extreme purity of the filling gas and quenching vapor was unnecessary, and less rigorous pumping than that associated with most electronic tubes was also permissible, the most important factors in obtaining good tubes being cleanliness and freedom from loose particles and lint. (auth)

4810

EFFECTS OF GEOMETRY ON SCATTERING DISTRIBUTIONS IN THE WILSON CLOUD CHAMBER. A. V. Crewe and A. E. Litherland. J. Sci. Instruments 28, 182-5(1951) June.

When a Wilson cloud chamber is used to study the scattering of charged particles, errors in the scattering distribution usually arise from the variation of the efficiency of detection with the scattering angle. A method is discussed whereby a correction can be applied for any particular arrangement of scattering foils and counters. In the case of a scattering distribution which is Gaussian, or can be expressed as a sum of Gaussians, the correction is particularly easy, reducing to a simple numerical integration. (auth)

4811

Atomic Energy Research Establishment, Harwell, Berks. (England)

THE FITTING OF A DISTRIBUTION CURVE OF KNOWN SHAPE, BUT ARBITRARY ORIGIN AND SCALE. D. J. Behrens. June 1951. 19p. (AERE T/M-50)

A particular case of the general exponential radioactive decay curve-fitting technique described in a previous report (AERE T/R 629, NSA 5-3733) has been applied for the fitting of a distribution curve of known shape, but arbitrary origin and scale.

4812

ELECTRONIC ASPECTS OF RADIATION INSTRUMENTS. E. E. Goodale and R. M. Lichtenstein. Natl. Electronics Conference 6, 443-54(1950) Sept. 25-7.

Some of the basic electronic problems peculiar to the field of radiation instruments are discussed. The characteristics of noise contained in the radiation or produced in the radiation detector are considered, together with methods for improving S/N ratios. Problems of bandwidth, overshoot, gain, and feedback in linear and nonlinear amplifiers are discussed.

4813
A LOCALIZING GEIGER COUNTER. S. G. F. Frank. Phil. Mag. 42, 612-15(1951) June.

The constant speed with which the discharge spreads along the wire in a Geiger counter is used to localize ionizing particles. Signals are obtained from the wire and also from two electrodes near its ends; from these signals a pulse is derived whose amplitude indicates the position of the initial ionizing event. Provision is made for stabilizing the speed of spread. (auth)

4814
A NEW METHOD OF RADIOACTIVE STANDARD CALIBRATION. Howard H. Seliger. Washington, D. C., U. S. Govt. Printing Office. 7p.

A review appears in Nucleonics 8, No. 6, 55-6(1951) June and is reproduced here in its entirety.

A method is described for making G-M counter measurements of different activity samples independent of intermittent disturbing effects. An example of a calibration procedure is given in which it has been possible to achieve a higher degree of accuracy in only 30% of original counting

4815
NUCLEAR PARTICLE AND RADIATION DETECTORS. PART I. ION CHAMBERS AND ION-CHAMBER INSTRUMENTS. D. Taylor and J. Sharpe. Proc. Inst. Elec. Engrs. 98(II), 174-90(1951) Apr.

The paper is a review of the operating mechanisms, special properties and constructional details of the particle and radiation detectors used in modern nuclear instruments. For the most part, the detectors described are those which are in use at the Atomic Energy Research Establishment, at Harwell, and the constructional techniques are those which have been found satisfactory under laboratory conditions there, or under production conditions in British industry. The emphasis in the paper is on the detectors themselves, but brief details are given of their use in complete instruments. The characteristics of the nuclear particles (α particles, β particles, protons, neutrons, fission fragments, etc.) and quanta (x rays and γ rays) to be detected are discussed, and classification of detectors is given, the principle of detection being explained in each case and attention being called to the two different methods of use, namely as counters responding to each individual ionizing event, and as integrating elements measuring the total energy dissipation over a given interval of time. The paper also gives a detailed description of the ion chamber—the theory of its operation and the practical details of its construction. Examples of its use in radiation monitoring apparatus and in assay instruments are given. Attention is called to the use of ion chambers in process-control instrumentation and in pile-control plants. It is proposed to give a full discussion of proportional counters, Geiger-Mueller counters and scintillation counters in Part 2 of the paper, to which this part (Part 1) forms an introduction. (auth)

4816
ON THE CHARACTERISTICS OF IONIZATION CHAMBER WITH SCREEN-GRID. (I). Kiichi Kimura, Kazunori Yuasa, Sukeaki Yamashita, and Ryutaro Ishiwari. Bull. Inst. Chem. Research Kyoto Univ. 23, 54-5(1950) Dec. (abstract)

A study of the characteristics of ionization chambers containing screen grids is noted briefly. The experimental results indicate that the inhomogeneity due to the inefficiency of the grid shielding for the electronegative gases is much smaller than in the case of electron collection owing to the fact that in the former case both positive and negative ions are utilized if the amplifier time constant is properly chosen.

4817
PRACTICAL ASPECTS OF RADIOACTIVITY INSTRUMENTS. I. CONSTRUCTION. W. C. Elmore, H. Kallman, C. E. Mandeville. Nucleonics 8, No. 6, S1-12(1951) June.

A basic guide to construction practices which are applicable to broad areas of instrumentation is presented. It is divided into two sections, circuits and detectors. In the discussion of circuits, components, chassis construction, and wiring are first discussed as they apply to all instruments, with differences between high- and low-level applications being pointed out. Then the special requirements of specific types of circuits are considered. In the section on detectors, G-M and proportional counters are discussed together; scintillation counters are considered without reference to the construction of photomultiplier tubes; and ionization chambers are treated in the final few paragraphs. 15 references.

4818
PRACTICAL ASPECTS OF RADIOACTIVITY INSTRUMENTS. III. CALIBRATION. L. D. Marinelli. Nucleonics 8, No. 6, S20-32(1951) June.

The field of radiation-detector calibration is surveyed, and the problems encountered in choice of units and in the setting up of universal standards are discussed. The calibration of various detectors for photons, α's, β's, and neutrons is discussed and comments are made on the actual state of the art.

4819
PRESENT STATE OF ROENTGEN DOSIMETRY. R. Jaeger. Z. angew. Physik 3, 191-8(1951) Apr. 15. (In German)

Methods of standard measurements of radiation units, as used in radiological and biological work, and in protection dosimetry, are discussed.

4820
THE PRINCIPLES OF CLOUD-CHAMBER TECHNIQUE. J. G. Wilson. Cambridge, University Press, 1951. 131p.

The following review appeared in J. Franklin Inst. 251, 657(1951) June and is reproduced here in its entirety.

Written primarily for those who use or plan to use the cloud chamber as a research tool, this book is not a guide to the construction of a cloud chamber, although a discussion of constructional materials is included. It is, rather, a description of the mechanics involved in its operation. The production and maintenance of suitable atmospheres are dealt with in chapters on the condensation and growth of drops, ionization in cloud tracks, and the production and maintenance of super saturation. The recording of data is treated in chapters on operation and photography and counter control. The technique of precision measurement of the recorded data is then discussed at some length, and the author concludes with a short discussion of the interpretation of cloud-chamber photographs.

4821
THE PROBLEM OF CONSTRUCTING A β SPECTROGRAPH ANALOGOUS TO AN OPTICAL SPECTROGRAPH. V. M. Kel'man and D. L. Kaminskiĭ. Zhur. Eksptl'. i Teoret. Fiz. 21, 555-61(1951) Apr. (In Russian)

It is shown that Klemperer's β spectrograph (Phil. Mag. 20, 545(1935)), consisting of two magnetic lenses and a deflecting magnet with round pole pieces, has no analogies with the optical spectrograph, its dispersion being zero. A true analogy is reached in another instrument whose construction is described here. Its magnet poles are narrow rectangles. The dispersion and the spectral-line width are calculated. (auth)

4822
THE PROPERTIES OF SPARK COUNTERS OF THE ROSENBLUM TYPE. R. D. Connor. Proc. Phys. Soc. (London) 64B, 30-44(1951) Jan.

The design and operation of Rosenblum-type spark counters having plane, concave, and convex cathodes is discussed with reference to the counting characteristics, useful life, and background counting rate. The absolute efficiency of the counter in air has been determined for α particles, knock-on protons, and β particles, giving values of about 90, 5, and 0.0002%, respectively. A marked dependence of efficiency on specific ionization and air pressure is evident. The counter is directional in all its forms. The effect of employing gases other than air is also investigated, and a qualitative description of the counting characteristics is given. α-particle ranges may be determined using either a single counter or two counters in anticoincidence as described in the text. (auth)

4823
A RAPID METHOD FOR THE MEASUREMENT OF CARBON 14 IN FORMAMIDE SOLUTION. A. Schwebel, Horace S. Isbell, and J. V. Karabinos. Science 113, 465-6(1951) Apr.

Brief report is made of the use of a rapid-counting method for the direct determination of radioactivity of substances containing C^{14}, employing a suitable solvent, namely, formamide. The apparatus is described. A net counts per second of 1.12 ± 0.01% of the disintegrations per second remained constant over an activity range of 1000 to 30,000 dps/ml.

4824
SCINTILLATION COUNTING EQUIPMENTS. R. B. Owen and E. A. Sayle. Proc. Inst. Elec. Engrs. 98(II), 245-51(1951) Apr.

Two types of scintillation counter, employing the VX 5045 multiplier photocell and a phosphor, are described. The alpha scintillation counting equipment is a complete instrument for counting samples of low activity over an area of 10 cm^2, at background rates of less than 2 counts/hr. A counting efficiency of 35% is obtained from a thin alpha-particle source with a comparative accuracy of ±1%. The scintillation gamma counter is designed as a probe unit for routine measurement of gamma-ray flux. Methods are given for the preparation of suitable phosphors. Using a thallium-activated sodium iodide phosphor, a counting efficiency of 22.5% was measured for 1.2-Mev gamma rays stable over long periods to ±1%. (auth)

4825
SLOW-NEUTRON DETECTION BY FOILS. I. C. W. Tittle. Nucleonics 8, No. 6, 5-9(1951) June.

The activation method of neutron detection is discussed briefly in general, as are the relative merits of Rh, Ag, Au, I, Dy, and In as detector materials. In measuring the 54-min activity of In, the undesired activity with 13-sec half life can be eliminated by waiting 3 min after exposure before beginning to count. The effect of fast-neutron activation of In^{115} (half life 4.5 hr) can be reduced by shortening the exposure time or increasing distance between foil and source. Resonance and thermal activations can be separated by surrounding the detector foil with 0.02 in., or more, of Cd, thus screening out the thermal neutrons. The difference between readings with and without Cd will be the thermal activation after a correction factor has been applied to account for absorption of some of the resonance neutrons by Cd. The In-foil thickness giving maximum thermal counting rate in water is ~100 mg/cm^2. If a low-sensitivity detector is required, detector material can be mixed with an inert element. 16 references.

4826
A SURVEY EQUIPMENT USING LOW-VOLTAGE HALOGEN-QUENCHED GEIGER-MÜLLER COUNTERS. E. Franklin and W. R. Loosemore. Proc. Inst. Elec. Engrs. 98(II), 237-44(1951) Apr.

The paper describes a small portable equipment for use by the private prospector in the location and approximate assay of radioactive ores. Its features are cheapness in cost and maintenance, simplicity of operation, long battery-life (2000 hr), robustness, lightness of weight (6 lb) and smallness of size (8⅞ in × 8 in × 3½ in). One quarter of full-scale deflection of the meter denotes the presence of bed rock containing 0.03% uranium oxide, U_3O_8 (0.003r/h for γ rays from radium), and full-scale deflection denotes that of 1% uranium oxide, U_3O_8 (0.018r/h). Cold-cathode valves are used in the instrument, one acting as a constant-amplitude oscillator feeding a miniature Cockroft-Walton voltage-quadrupler producing a stabilized voltage output. The moulded plastic container is completely weatherproof. The G-M counter tubes use bromine as the quenching agent, have thresholds of about 300 to 330 volts, and have very long lives. The range of temperature over which they will operate is from −50 to +40°C, the temperature coefficient of threshold voltage being less than 0.2 v/°C. Plateaus are 100 v in length, with slopes from 0.03 to 0.1%/v. The counters may be operated at ±800 v without damage. Their efficiency is not appreciably different from that of standard tubes. (auth)

MESONS

4827
Rochester Univ.
CROSS-SECTION FOR THE REACTION $\pi^+ d \rightarrow p + p$ AND THE SPIN OF THE π^+ MESON. D. L. Clark, A. Roberts, and Richard Wilson. June 6, 1951. 4p. (NYO-896)

The total cross section for the reaction $\pi^+ + d \rightarrow p + p$ has been measured. 40-Mev mesons produced by bombardment of an Al target with 240-Mev protons were reduced to 33 Mev by passing through a three-fold scintillation counter telescope and were allowed to enter a D_2O target. Protons produced in the D_2O were detected in coincidence by two large NaI scintillation counters. The measured total cross section is compared to that predicted by detailed balancing for different values of A in an assumed angular dependence of the form $A + \cos^2 0$ (c.m. system). Assuming $A = 0.2 \pm 0.1$, the measured total cross section for 23-Mev mesons is 4.5 ± 0.8 mb. It is concluded that the spin of the π^+ meson is zero.

4828
Radiation Lab., Univ. of California
ENERGY SPECTRUM OF THE ELECTRONS FROM μ^+ MESON DECAY. Ryokichi Sagane, William L. Gardner, and Harmon W. Hubbard. Mar. 19, 1951. 6p. (UCRL-1188)

This report was published as a letter to the editor in Phys. Rev. 82, 557-8(1951) May 15, and abstracted in Nuclear Science Abstracts as NSA 5-4508.

4829
Radiation Lab., Univ. of California
MESON INDUCED FISSION. Sue Gray Al-Salam. Apr. 1951. 18p. (UCRL-1201)

Several batches of plates loaded with uranyl acetate have been exposed to π^- mesons in the Berkeley cyclotron. The mesons were generated by the 350-Mev proton beam striking a carbon target and the plates were shielded from the direct beam, or positive particles generated at the target, by several inches of Cu. They received negative mesons over a wide range of energies. About 1 in 100 of the mesons

observed to end in these plates ended in a characteristic fission event. Twenty-two such fissions were observed. This was in rough qualitative agreement with what might be expected if it is assumed that the capture of a negative π meson by the U nucleus always produces fission. Three of these events showed 3-way fission, a light particle coming off at about 90° to the tracks of the heavy fission fragments. (auth)

4830

Radiation Lab., Univ. of California

MESON MASSES AND ENERGETICS OF MESON DECAY. Walter H. Barkas. May 15, 1951. 25p. (UCRL-1285)

Experiments performed at the University of California Radiation Laboratory during the past year to provide information on meson masses and on the energy balance in the decay of charged mesons are reviewed. This paper is primarily a report on the progress made, rather than a detailed discussion of any particular experiment. Results of several measurements are compared, and diagrams illustrate the principles employed. Ten references are included for detailed accounts of the individual experiments.

4831

GENERATION OF NEUTRAL MESONS BY γ QUANTA. A. Baldin and V. Mikhaĭlov. Zhur. Ekspti'. i Teoret. Fiz. 21, 562-3(1951) Apr. (Letter to editor; in Russian)

Discrepancies between the theory of the generation of neutral and positive mesons (Brueckner et al., Phys. Rev. 79, 187(1950)) and the experiment (Steinberger et al., Phys. Rev. 78, 802(1950)) can be explained by assuming that the interaction between an electromagnetic field and a nucleon is essentially an interaction between the field and an anomalous magnetic moment, and that the observed anomalous moment is due to mesons of various types. A phenomenological examination of the problem shows that only the pseudoscalar meson theory agrees with the observations.

4832

INTERACTION OF MESONS WITH NUCLEI. Satio Hayakawa. Phys. Rev. 82, 836-9(1951) June 15.

The interaction of slow π mesons with nuclei is treated phenomenologically. A nucleus is assumed to be a continuum with potential with respect to a meson. The potential consists of real and imaginary parts, corresponding to the polarization caused by a meson and the absorption of a meson, respectively. The scattering, the absorption, and the production of mesons are qualitatively discussed by analogy with the current theory of nuclear reactions. The difference from the theory based on the weak interaction of mesons with nucleons is presented. (auth)

4833

INTERACTION OF Pi-MESONS WITH CARBON AND ALUMINUM NUCLEI. M. Camac, D. R. Corson, R. M. Littauer, A. M. Shapiro, A. Silverman, R. R. Wilson, and W. M. Woodward. Phys. Rev. 82, 745-6(1951) June 1. (Letter to the editor)

By means of a double-focusing magnetic analyzer, π mesons (80% having energy between 50 and 70 Mev) were allowed to enter a cloud chamber in which either C or Al plates were mounted. The number of nuclear events recorded corresponds to an interaction cross section for C of 0.22 ± 0.05 barn, and for Al of 0.48 ± 0.14 barn. The geometrical cross sections are respectively 0.37 and 0.60 barn. The C nucleus seems to be roughly 60% transparent to mesons of energy 20 to 60 Mev. The data for Al are consistent with a nuclear transparency of $\sim 80\%$ but do not exclude a "black" nucleus. An additional result of the experiment, obtained by reversing the magnetic field of the analyzer, is the ratio of negative to positive mesons produced in several targets. For meson energies between 55 and 70 Mev this ratio is 1.12 ± 0.07 for C and 2.40 ± 0.20 for Be.

4834

ON THE THEORY OF STRONG COUPLINGS BETWEEN NUCLEONS AND PSEUDOVECTOR MESONS. Klaus Rüdenberg. Helv. Phys. Acta 24, 89-126(1951) Apr. 10. (In German)

The calculation of nuclear forces in meson-field theories by perturbation theory is hindered by the fact that, whereas the latter presupposes weak couplings, the actual interactions are strong. Wentzel (Revs. Modern Phys. 19, 1-18 (1947)) obviated this difficulty by introducing an expansion in a descending power series of the coupling parameter, and a number of writers then investigated the problem along these lines in all but the pseudovector variants of the thoery; the results revealed important contradictions with experiment. Using the same methodology, an examination of the pseudovector theory is made, the specific purposes being the determination, in the usual approximation, of the "isobar energy" and of the static nuclear forces.

4835

PRODUCTION OF PHOTOMESONS. Raphael M. Littauer and Darcy Walker. Phys. Rev. 82, 746-7(1951) June 1. (Letter to the editor)

The beam of bremsstrahlung from the Cornell 300-Mev electron synchrotron was allowed to strike targets containing various elements in their natural isotopic compositions. Charged mesons emitted at 135°, and of energies about 50 Mev, were selected by a double-focusing system of magnets and detected in an array of coincidence counters. Assuming that the photoproduction of mesons takes place according to the reactions $p + \gamma \rightarrow n + \pi^+$ and $n + \gamma \rightarrow p + \pi^-$, the production cross sections have been calculated for H^1, D^2, Be^9, C^{12}, O^{16}, F^{19}, Al^{27}, S^{32}, Ca^{40}, and Bi^{209}. Cross sections per relevant nucleon for π^+ and π^- production, the ratio of π^-/π^+, and the sum $(\pi^- + \pi^+)$ are each plotted against mass number. For the symmetrical nuclei D, C, O, S, and Ca, the π^-/π^+ ratio, which is 1.19 ± 0.12 for D, shows a steady decrease with increasing A, reaching the value 0.58 ± 0.06 for Ca. The nuclei Be^9, F^{19}, and Al^{27}, each with an unpaired neutron, have π^-/π^+ ratios lying considerably above the curve for symmetrical nuclei. The heavy nucleus Bi^{209}, which contains 50% excess neutrons, has a π^-/π^+ ratio of only 1.32 ± 0.12.

MOLECULAR STRUCTURE

4836

INTERMOLECULAR POTENTIALS. I. CARBON TETRAFLUORIDE AND SULFUR HEXAFLUORIDE. II. CARBON DIOXIDE. K. E. MacCormack and W. G. Schneider. J. Chem. Phys. 19, 849-55(1951) July.

Experimental second virial coefficient data for carbon tetrafluoride, sulfur hexafluoride, and carbon dioxide have been used to investigate the intermolecular potentials of these molecules on the basis of a Lennard-Jones model Force constants for the fluoride molecules can be fitted rather satisfactorily, but the constants so derived do not agree with those derived from other gaseous properties, e.g., the critical data. This result may be due to the assumption of central forces for the symmetrical fluoride molecules. For carbon dioxide it was found that the derived force constants varied with temperature, the high temperature data yielding lower values of the collision diameter r_0. The results can be interpreted on the basis of a partial association. A likely configuration for the resulting dimer is suggested. (auth)

4837

THE $3p^3\Sigma - 2s^3\Sigma$-BANDS OF TH AND T_2. G. H. Dieke and F. S. Tomkins. Phys. Rev. 82, 796-807(1951) June 15.

The molecular spectra of TH and T_2 were photographed under high dispersion. The classification of the $3p^3\Sigma - 2s^3\Sigma$-system is given for these two molecules as well as the molecular constants for the $3p^3\Sigma$-state. Irregularities in the structure including typical perturbations are accounted for by interaction with the $3p^3\Pi$-state. This system, with 58 known bands and more than 1150 classified lines, is now known considerably better for T_2 than for any other species of hydrogen molecule, including H_2. 7 tables. (auth)

NEUTRONS

4838

Metallurgical Lab., Univ. of Chicago

SOLUTIONS OF BOLTZMANN'S EQUATION FOR MONOENERGETIC NEUTRONS IN AN INFINITE HOMOGENEOUS MEDIUM. E. P. Wigner. Nov. 30, 1943. Decl. July 31, 1951. 19p. (AECD-3215; CP-1120; A-1608)

Boltzmann's equation is solved for the case of monoenergetic neutrons created by a plane or point source in an infinite medium which has spherically symmetric scattering. The customary solution of the diffusion equation appears to be multiplied by a constant factor which is smaller than 1. In addition to this term the total neutron density contains another term which is important in the neighborhood of the source. It varies as $1/r^2$ in the neighborhood of a point source. (auth)

4839

Watertown Arsenal and Brookhaven National Lab.

NEUTRON CRYSTAL MONOCHROMATORS. R. J. Weiss, J. Hastings, and L. Corliss. [nd] 6p. (AECU-1373)

The existence of several maxima in the diffracted beam from single crystals irradiated with highly collimated thermal neutrons is attributed to lineage structure in the crystal as are discrepancies between experimental double-crystal rocking curves and their interpretation by the dynamical theory of x-ray diffraction. Crystals of Be, Mg, Cu, Ni, Pb, Bi, NaCl, and LiF grown from the melt were found to contain pronounced lineage. In the case of Pb, lineage was reduced considerably by thermal annealing. Because of this property, and the ease of growth, high coherent cross section, and low neutron absorption, Pb is recommended as a suitable monochromator for neutrons.

4840

THE RADIOACTIVE DECAY OF THE NEUTRON. J. M. Robson. Phys. Rev. 83, 349-58(1951) July 15.

The protons from the radioactive decay of the neutron have been identified by measuring their charge to mass ratio with an electrostatic field and magnetic lens spectrometer. Coincidences have been obtained between these protons and the corresponding beta-particles from the neutron decay using a second magnetic lens spectrometer to measure the energies of the beta-particles. In this manner the beta-spectrum of the neutron has been measured over the region from 300 kev to the end point and has been found to be consistent with the energy distribution expected for an allowed transition. The end point of the spectrum is 782 kev with a probable error of ±13 kev. The half-life of the neutron is 12.8 min with a probable error of ±2.5 min. (auth)

4841

Atomic Energy Research Establishment, Harwell, Berks. (England)

SOME REMARKS ON APPLICATION OF THE SPHERICAL HARMONICS METHOD IN THE CASE OF COMPLEX GEOMETRIES. B. Davison. [nd] 19p. (AERE-T/R-700)

In the solution of neutron transport theory problems, a new procedure is given for setting down the spherical-harmonics-method equations and reducing them to the equations for one unknown at a time for the cases when the angular distribution depends on both angles characterizing the direction of a neutron. The essence of this new procedure is that in the earlier stages of the calculation one works in the Cartesian coordinates, and treats all the harmonics of any particular order en bloc. The subdividing of the harmonic of order s into its (2s + 1) components and the passage to the system of coordinates appropriate to the particular geometrical arrangement are carried out after the system of equations has been reduced to equations for one unknown at a time. The new procedure is illustrated by applying it to the case of a finite cylinder. (auth)

NUCLEAR PHYSICS

4842

ANGULAR DISTRIBUTIONS OF PROTONS FROM THE REACTION $^{12}C(d,p)^{13}C$. J. Rotblat. Nature 167, 1027-8(1951) June 23. (Letter to the editor)

Angular distributions of protons from the reaction $C^{12}(d,p)C^{13}$ were studied for the two groups of protons corresponding to the ground state and first excited state of C^{13}; the results agree with calculations by Butler (Proc. Roy. Soc. A, in press; Phys. Rev. 80, 1095(1950)) if angular momentums of 1 for the neutrons captured to form C^{13} in the ground state and 0 for neutrons captured into the 3.11-Mev state of C^{13} are assumed. Since C^{12} has spin 0 and even parity, it follows that the ground-state of C^{13} must have spin ½ (known from direct observation) and odd parity, and the 3.11-Mev state spin ½ and even parity.

4843

CONSERVATION OF ANGULAR MOMENTUM IN THE STATISTICAL THEORY OF NUCLEAR REACTIONS. W. Wolfenstein. Phys. Rev. 82, 690-6(1951) June 1.

The conservation of total angular momentum J, z-component of angular momentum m, and parity p are considered in connection with the statistical theory of nuclear reactions. Results are obtained for the angular distribution of a single group of outgoing particles and for the cross section as a function of the spin of the residual nucleus. The energy and angular distributions are also considered for the case in which many groups are observed simultaneously. The density of nuclear states as a function of spin affects results appreciably. (auth)

4844

INTRODUCTION TO NUCLEAR ISOMERISM. L. Hurtado. Ion 11, 146-53,181(1951) Mar. (In Spanish)

A short treatment of the principles of nuclear transformations and, in particular, of nuclear isomerism is presented.

4845

ON THE THEORY OF THE BERYLLIUM NUCLEUS. V. Chavchanidze. Uspekhi Fiz. Nauk 43, 106-19(1951) Jan. (In Russian)

An outline of the present state of the structure theory of the Be nucleus is presented. 25 references, of which 11 are Russian.

NUCLEAR PROPERTIES

4846

Wisconsin Univ.

LOW EXCITED STATES IN Li^6 AND Be^9. C. P. Browne, R. M. Williamson, D. S. Craig, and D. J. Donahue. [nd] 5p. (AECU-1352)

Protons of well-defined energy were allowed to strike targets of thin Be foils or thin layers of Be evaporated onto Ni foils of 1×10^{-5} cm thickness. The energy of particles emitted at 135° from the incoming beam were measured with a spherical electrostatic analyzer. A plot of the number of emitted particles vs. energy for an incident beam energy of 2.35 Mev shows peaks corresponding to singly, doubly, and triply charged Li^6 particles and doubly charged α particles

from the ground state reaction. In addition, peaks attributed to singly and doubly charged α particles from the excited state are seen. Elastically scattered protons from Be and the singly charged ground-state alphas have energies beyond the range of this plot. It was concluded that the alphas come from a reaction in Be. Using the value of 2.123 ± 0.003 Mev for the Q of the ground state reaction, the energy level of Li^6 is determined to be 2.187 ± .008 Mev. Inelastically scattered protons from the energy level in Be^9 were observed at bombarding energy of 3.46 Mev and the level was determined by the author to be 2.433 ± .005 Mev.

4847

Brookhaven National Lab.

CLASSIFICATION OF NUCLEAR ISOMERS. M. Goldhaber and A. W. Sunyar. May 22, 1951. 35p. (AECU-1406)

The report shows that the γ probability of an isomeric transition of a given type, characterized by spin and parity change, is fairly accurately determined by the energy change if reasonable allowances are made for (a) the competition of internal-conversion transitions, (b) the statistical weights of the initial states, and (c) the nuclear radius. It is shown that the matrix element of the transition varies but little from one nucleus to another. Empirical relationships are established between the measured ratios of conversion coefficients from the K and L electron shells and the energy of the transition. The excited states of nuclei, in those cases where the ground state and the decay scheme are known and the excited state can be fully identified, prove to be low-lying levels adjacent to the ground state in the scheme of Mayer based on spin-orbit coupling. Empirical curves of K/L ratios vs. Z^2/E are given. They are consistently lower than the theoretical curves. Spins of metastable and ground states are assigned for a number of nuclei. For even-even nuclei the first excited state has usually a spin I = 2 and even parity.

4848

Wisconsin Univ.

LOW STATES OF F^{17} AND NEUTRONS FROM O^{18} + D. Fay Ajzenberg. [nd] 6p. (AECU-1503)

A thin (<80 kev) tungsten oxide target was bombarded by 3.083-Mev deuterons. The resultant neutron spectrum was observed by means of Eastman NTA nuclear emulsions, 100 μ thick, mounted 10 cm from the target and at angles of 0, 10, 20, 30, and 90° to the direction of the beam. A total of 1700 tracks were measured. Neutron groups corresponding to a first excited state of F^{17} at 536 ± 10 kev were observed at ~0.7 Mev for the 0 to 30° data. Graphs of the relative intensities of the ground-state neutron groups and of the 536-kev excited state neutron groups as a function of angle (c.m. system) are compared with Butler's theoretical curves (Phys. Rev. 80, 1095(1950)). Results are consistent with an assignment of $S_{1/2}$ to the first excited state of F^{17}, and it appears that the 0.536-Mev level of F^{17} and the 0.88-Mev level of O^{17} are the mirror levels expected from the equality of n-n and of p-p forces.

4849

Wisconsin Univ.

ASSIGNMENT OF ANGULAR MOMENTA TO THE ENERGY LEVELS OF F^{17}. R. A. Laubenstein and M. J. W. Laubenstein. [nd] 50p. (AECU-1504)

An analysis of data (Laubenstein et al., AECU-1510) on the elastic scattering and capture of protons by oxygen was made for the purpose of assigning angular momenta to certain energy levels in F^{17}. The elastic scattering data were analyzed by a graphic method wherein the phase and amplitude of the refracted partial waves are represented by vectors in the complex plane. As the proton energy is varied over a resonance, a circular locus is obtained for the vector that represents the component of a partial wave which excites the resonance. Assignments of angular momenta to the energy levels of F^{17} are made as follows: ground state, $D_{5/2}$; 0.55 Mev, $S_{1/2}$; 3.11 Mev, $S_{1/2}$; 3.88 Mev, $F_{1/2}$; 4.36 Mev, $D_{5/2}$; and 4.73 Mev, $P_{3/2}$. The assignments of the 0.55-, 3.11-, and 3.88-Mev levels are reasonably certain, but the others are based on less substantial evidence. The reduced width of the 3.11-Mev $S_{1/2}$ level was found to be about 0.048×10^{-13} Mev-cm, while the 0.55-Mev $S_{1/2}$ level probably has a reduced width over 100 times as large. The slowly rising capture cross section observed from 1.4 to 3.4 Mev is probably caused by the broad 0.55-Mev level. A comparison of the levels in the mirror nuclei O^{17} and F^{17} shows a similar structure. (auth)

4850

Wisconsin Univ.

LOW EXCITED STATES OF NUCLEI AND THE QUASI-ATOMIC MODEL. H. L. Jackson, R. K. Adair, and L. J. Koester, [nd] 8p. (AECU-1517)

The independent particle, or quasi-atomic model of the nucleus, has been used to discuss the ground states of nuclei and the doublet splitting in light nuclei. Recent experiments on the elastic scattering of protons by He^4, C^{12}, O^{16}, and of neutrons by He^4 have been analyzed, and assignments of angular momentum and parity have been made to the excited states observed. These quantum numbers have also been determined for some of the low states of Al^{25} by an analysis of the scattering of protons by Mg^{24}. (auth)

4851

Radiation Lab., Univ. of Calif.

INTERPRETATION OF (d,n) ANGULAR DISTRIBUTIONS. (abstract) W. Heckrotte and L. Schecter. May 3, 1951. 1p. (UCRL-1273)

This report is reproduced here in its entirety.

A continuation of the work (Reported on at the Washington Meeting of the American Physical Society, Apr. 26-28, 1951) on the angular distribution of neutrons which result from bombardment by 20-Mev deuterons from the 60-in. cyclotron at Berkeley is in progress. Assignment of parities and possibly spin values to the final states of the product nuclei has been extended to include the reactions C^{12}(d,n) N^{13}, Co^{59}(d,n) Ni^{60}, and Au^{197} (d,n)^{198} on the basis of Butler's analysis. (Phys. Rev. 80, 1095 (1950)). For the C^{12}(d,n) N^{13} reaction, the experimental method allows the detection of the neutrons which result from the formation of the ground state of N^{13}. On this basis the assignment of odd parity and possible spin values of ½, 3/2 is made. This is in agreement with the shell model prediction of a $P_{1/2}$ state. Similar information will be reported upon concerning the other reactions.

4852

THE ATOMIC MASSES OF H^1, D^2, AND C^{12}. A. H. Wapstra. Phys. Rev. 82, 756-7(1951) June 1. (Letter to the editor)

The masses of H^1, D^2, and C^{12} have been computed from nuclear reaction data and are compared with those obtained from spectrographic data by Nier and Roberts (Phys. Rev. 81, 507, 624(1951)). The following values are given for M−A in terms of 10^{-6} amu: H^1, 8146 ± 3; D^2, 14,740 ± 4; C^{12}, 3807 ± 19.

4853

THE INTERNAL CONVERSION COEFFICIENTS. I. THE K-SHELL. M. E. Rose, G. H. Goertzel, B. I. Spinrad, J. Harr, and P. Strong. Phys. Rev. 83, 79-87(1951) July 1.

The internal conversion coefficients for electric and magnetic multipole radiation have been computed for the K-shell in the relativistic case with the unscreened coulomb field acting on the electron. The numerical results, which are obtained to four-significant-figure accuracy, were computed on the automatic sequence relay calculator

(Mark I) and are given here for 12 values of Z in the range $10 \leq Z \leq 96$ and 6 γ-ray energies (between 0.3 and 5.0 mc^2) for the first five electric and first five magnetic multipoles. (auth)

4854

Atomic Energy Research Establishment, Harwell, Berks. (England)

LIST OF PAPERS ON NUCLEAR INDUCTION STUDIES WITH PARTICULAR REFERENCE TO NUCLEAR AND PARAMAGNETIC ADSORPTION. June 1951. 18p.

This list of papers on the title subject has been compiled mainly from Science Abstracts A, 1946 onward, and from Nuclear Science Abstracts. With the main reference to the journal in which the paper appeared, there is also given the reference to the abstract in the abstracting journal.

4855

PROPERTIES OF (γ,n) CROSS SECTIONS. L. Marshall. Phys. Rev. 83, 345-8(1951) July 15.

The mean energies of photons producing the reactions $Cu^{63}(\gamma,n)Cu^{62}$, $Zn^{64}(\gamma,n)Zn^{63}$, and $C^{12}(\gamma,n)C^{11}$ have been found by measuring their absorption coefficients for many values of Z. Monitor and detector were made of the element investigated. The absorbers were Be, C, Al, Ti, Fe, Ni, Cu, Zn, Se, Mo, and Sn. Less than 1 percent of the radiation striking the detector originated in the absorber. In this geometry, $(1/Z) \times$ absorption cross section was a linear function of Z. The Compton cross section was separated from the pair cross section by considering its different Z-dependence. The mean energy was evaluated in two ways: (1) from the observed pair cross section and the Bethe-Heitler formula, and (2) from the observed Compton cross section and the Klein-Nishina formula. A correction was applied for the deviation of pair cross section from the value given by the Born approximation. With this correction, the values of the mean energy were found to be as follows:

	from Compton cross section	from pair production
Zn^{64}	16.6 Mev	20.0 Mev
Cu^{63}	17.3	21.0
C^{12}	23	32

The integrated (γ,n) cross sections for C^{12} and Zn^{64} have been found to be 0.086×10^{-24} Mev-cm^2 and 0.77×10^{-24} Mev-cm^2, respectively. (auth)

NUCLEAR REACTORS

4856

Metallurgical Lab., Univ. of Chicago

THE DIFFUSION LENGTH AND THE UTILIZATION OF THERMAL NEUTRONS IN A HETEROGENEOUS PILE. Gilbert N. Plass. Oct. 6, 1943. Decl. July 31, 1951. 27p. (AECD-3214; CP-992)

An accurate calculation is given for the quantity which corresponds to the diffusion length in the theory of the pile. The procedure used is to establish a relationship between the diffusion length and the change in thermal utilization from a pile with infinite sides to one with sides of a finite length. The calculation of this change in the thermal utilization is then carried through. Approximations and numerically exact calculations are given. The results show that for radii very near the optimum values the exact diffusion length is slightly larger than the one obtained from the usual formula, $L_a^2 = (1/\kappa_1^2)(1 - P_{20})$. However, over most of the range of radii the exact diffusion length is smaller than than the approximate one. (auth)

4857

Metallurgical Lab., Univ. of Chicago

THE LEAKAGE OF NEUTRONS FROM A HETEROGENEOUS PILE. Gilbert N. Plass. Dec. 27, 1943. Decl. July 31, 1951. 7p. (AECD-3217; CP-1174; A-1656)

The leakage of neutrons from a heterogeneous pile with finite sides is calculated by a development of the method used in Report CP-992. The fraction of neutrons absorbed by the moderator is obtained from the results of the calculation of the leakage. (auth)

4858

Knolls Atomic Power Lab.

CONTROL OF AN ATOMIC POWER PLANT. J. H. Pigott and J. I. Owens. May 11, 1951. 13p. (AECU-1511)

Functions of the control system for an atomic power plant are discussed with regard to control of the safety system, the control required to compensate for long-term changes in reactivity, and the power regulating control. Fundamentals of reactor kinetics are reviewed briefly.

4859

Atomic Energy Research Establishment, Harwell, Berks. (England)

AN APPARATUS FOR THE PILE IRRADIATION OF LIQUIDS. B. D. Pate. Mar. 12, 1951. 9p. (AERE-C/R-643)

Facilities for the irradiation of liquids in the Harwell pile have recently been improved by construction of a special apparatus. The liquid to be irradiated is contained in a silica tube of 15 mm external diameter and somewhat less than 10 cm long. One end is sealed and the other joined to a 10 cm neck of 5 mm diameter silica tubing, the top end of which is open. Eight of these tubes are supported in a graphite housing, which is built up from three types of segment. The assembled housing has a central channel running its entire length, which permits introduction of the extractor rod. The whole assembly is designed to fit into the standard isotope cylinder. When filled, the tubes are found to be proof against spilling, if accidentally inverted, and to be unaffected by mild mechanical or thermal shock. During irradiation, however, gas evolution can freely occur without spilling any active liquid. The design is described and diagrammed in detail.

4860

BEPO: BRITISH EXPERIMENTAL PILE. Nucleonics 8, No. 6, 36-7(1951) June.

Construction details for the larger of the two Harwell piles are described. Bepo is a graphite moderated, induced air-cooled pile with a central thermal-neutron flux of 10^{12} n/cm^2/sec. Control of the pile is effected by four boron-carbide-filled hollow steel rods 2 in. in diam. These rods can be accurately positioned by push-button controls. A second system of 10 similar rods, known as shutdown rods, operate vertically in the pile. They have two positions only, in or out. When both systems are fully inserted the fission rate within the pile is about 1 mw.

NUCLEAR TRANSFORMATIONS

4861

Wisconsin Univ.

NUCLEAR REACTIONS RESULTING FROM THE PROTON BOMBARDMENT OF ALUMINUM. F. C. Shoemaker, J. E. Faulkner, G. M. B. Bouricius, S. G. Kaufmann, and F. P. Mooring. [nd] 25p. (AECU-1362)

The energy dependence of reaction-product yields from Al bombarded by protons has been measured in the energy range 1.4 to 4 Mev with fairly high energy resolution. Yield curves are shown for elastically scattered protons, α particles (both full energy and those leaving the residual nucleus Mg^{24} in the first excited state), γ radiation, and, over a limited range, inelastically scattered protons leaving the residual nucleus Al^{27} in the first two excited states. The γ-ray yield at proton energies above 2 Mev is shown

to be principally from the excited residual nuclei. All reactions show a pronounced resonance structure.

4862
Wisconsin Univ.
BERYLLIUM AND TRITIUM REACTION ENERGIES. (abstract) R. M. Williamson, C. P. Browne, D. J. Donahue, D. S. Craig, and K. W. Jones. [nd] 1p. (AECU-1363)

The report is reproduced here in its entirety.

The following preliminary Q values have been obtained.

Reaction	Q (Mev)
$Be^9(p,p')Be^{9*}$	−2.43
$Be^9(p,d)Be^8$	+0.5581
$Be^9(p,x)Li^8$	2.123
$Be^9(p,Li^8)He^4$	2.136
$Be^9(p,x)Li^{8*}$	−0.06
$Be^9(d,Li^7)He^4$	7.175
T(d,x)n	17.75

Final values and estimated errors, along with data on target contamination and magnetic field effects, will be given. The level at 2.18 Mev (corresponding to Q = −0.06 Mev) reported in Li^8 was observed at three different bombarding energies and is believed to be the level at 2.3 Mev previously reported (Hornyak, Lauritsen, Morrison, and Fowler, Revs. Modern Phys. 22, 304 (1950) from $Li^7(d,t)Li^{8*}$ reaction. The target of tritium in thick zirconium showed a rapid decrease of tritium density near the surface. It is, therefore, only possible at present to put a lower limit on this Q.

4863
Wisconsin Univ.
ELECTROSTATIC ANALYSIS OF LITHIUM REACTIONS. (abstract) D. S. Craig, C. P. Browne, D. J. Donahue, R. M. Williamson, and R. E. Benenson. [nd] 1p. (AECU-1364)

This report is reproduced here in its entirety.

Kinetic energies of product particles of the following reactions have been measured with a spherical electrostatic analyzer (D. S. Craig et al., Phys. Rev. 81, 304 (1951) using an energy resolution of 500. Bombarding particle energies were determined by a cylindrical electrostatic analyzer calibrated against the $Li^7(p,n)Be^7$ threshold. The angle of observation (134°32′) of the product particles was determined by direct measurement and by scattering protons from a deuterium target. The following are preliminary Q values. Estimates of uncertainties will be given.

Reaction	Q (Mev)
$Li^8(p,He^3)$	4.027
$Li^7(d,p)Li^8$	−0.181
$Li^7(p,p')Li^{7*}$	−0.4788
$Li^7(d,d')Li^{7*}$	−0.4773

4864
Wisconsin Univ.
CROSS SECTION FOR THE $B^{10}(n,\alpha)$ REACTION FROM 0.35 TO 2.6-MEV NEUTRON ENERGY. (abstract) D. W. Miller, Ben Petree, and C. H. Johnson. [nd] 1p. (AECU-1378)

This report is reproduced here in its entirety.

The cross section for the $B^{10}(n,\alpha)$ reaction was measured as a function of neutron energy using a cylindrical proportional counter containing BF_3 and argon. Good pulse height resolution was obtained in this counter by the use of guard sleeves around the central wire which were held at an intermediate voltage to reduce end effects. Disintegration pulses from the counter were recorded photographically. The disintegration cross section was found to lie below the 1/v extrapolation of the thermal cross section except at the peak of a resonance observed at 1.9 Mev, where the cross section coincides with the 1/v extrapolation. This resonance has a width of about 400 kev, a peak value of 0.53 barn, and a total variation of the cross section of 0.35 barn. The ratio of the number of disintegrations leading to the ground state of Li^7 to the number leading to the excited state increases smoothly from 0.2 at 0.35 Mev to a maximum of 2.3 at 1.9 Mev, and decreases again to 0.8 at 2.6 Mev.

4865
Brookhaven National Lab.
GAMMA-RAY TRANSITIONS IN B^{10}. David E. Alburger. May 17, 1951. 4p. (AECU-1397)

Consideration is given to the energy-level scheme proposed by Ajzenberg (Phys. Rev. 82, 43(1951)) for B^{10} based on observation of neutron groups from the $Be^9(d,n)B^{10}$ reaction. Previous investigations of the γ-ray spectrum by Rasmussen et al., (Phys. Rev. 76, 581(1949)) were consistent with the proposed level scheme, but a γ-ray transition from the 1.73-Mev second-excited state of B^{10} to ground state was not observed. The γ-ray spectrum from the $Be^9(d,n)B^{10}$ reaction has been reinvestigated using a deuteron beam from the Brookhaven electrostatic accelerator and a magnetic lens spectrometer to measure the resulting spectrum of prompt γ radiation. No 1.73-Mev transition was found.

4866
Brookhaven National Lab. Carnegie Inst. of Washington
EXCITATION CURVE FOR THE $H^3(p,\gamma)He^4$ REACTION. C. E. Falk and G. C. Phillips. [nd] 4p. (AECU-1423)

In order to investigate the existence of a He^4 excited level near 23 Mev suggested by Argo et al. (Phys. Rev. 78, 691(1950); ibid. 79, 929(1950)), the excitation curve for the $H^3(p,\gamma)He^4$ reaction has been extended to 3.4 Mev. The target consisted of T_2 absorbed in Zr evaporated on a W button, the monoenergetic beam of protons was produced by the Department of Terrestrial Magnetism, electrostatic generator, and the γ-ray yield was detected by a large NaI(Tl) crystal with linear response and subtending a half-angle of 25°. The slope of the excitation curve is less than that of Argo et al., and indicates that no large resonance exists up to 3.4-Mev proton energy. A weak (up to 30%) broad resonance superimposed on the rising cross section is not ruled out, however.

4867
Wisconsin Univ.
TOTAL NEUTRON CROSS SECTIONS OF MAGNESIUM AND SILICON. R. E. Fields and M. Walt. [nd] 5p. (AECU-1454)

Total cross sections of Mg and Si for fast neutrons with energies <800 kev have been measured. Fast neutrons were produced by bombarding a Li target with protons from an electrostatic generator. At neutron energies from about 135 to 800 kev neutrons emitted in the forward direction were used, while at lower energies observations were carried out at an angle of 115° to the incident proton beam. Cross sections were determined from simple transmission measurements. A plot of total cross section vs. energy for Si shows peaks at 195 and 570 kev of 12 and 5.5 barns rise, respectively, due apparently to interaction with Si^{28} and indicating probable compound nucleus spins of ½ and >½, respectively. For Mg, maxima at 85,275 (broad peak), and 430 kev are presumed to result from Mg^{24}. Respective rises of 19, 8, and 8 barns indicate probable compound nucleus spins of ½, ½, and ⅗. The present data are in qualitative agreement with measurements reported by Frier et al. (Phys. Rev. 78, 508(1950)).

4868
Wisconsin Univ.
DISINTEGRATION OF BORON BY FAST NEUTRONS. B. Petree, C. H. Johnson, and D. W. Miller. [nd] 23p. (AECU-1501)

The cross section for the $B^{10}(n,\alpha)$ reaction has been measured as a function of neutron energy from 0.35 to 2.6 Mev. The cross section was found to lie below the 1/v extrapolation of the thermal cross section except at a peak observed at 1.9 Mev. This peak has a width of about 400 kev and a maximum value of 0.53 barn. The total variation of the cross section at the peak is 0.35 barn. The ratio of the number of disintegrations leading to the ground state of Li^7 to the number leading to the excited state increases smoothly from 0.2 at 0.35 Mev to a maximum of 2.3 at 1.9 Mev, and decreases again to 0.8 at 2.6 Mev. (auth)

4869
Wisconsin Univ.
ELECTROSTATIC ANALYSIS OF NUCLEAR REACTION ENERGIES. R. M. Williamson, C. P. Browne, D. J. Donahue, and D. S. Craig. [nd] 28p. (AECU-1502)

Electrostatic analyzers for incident and product particles of of nuclear reactions have been employed to measure ground-state Q values as follows: $Li^6(p,He^3)$, 4.024 ± 0.005 Mev; $Li^7(d,p)Li^8$, −0.192 ± 0.001 Mev; $Be^9(p,d)Be^8$, 0.558 ± 0.002 Mev; $Be^9(p,\alpha)Li^6$, 2.123 ± 0.004 Mev; $Be^9(d,Li^7)\alpha$, 7.159 ± 0.009 Mev. Absolute energy calibration was based on a $Li^7(p,n)Be^7$ threshold of 1.882 ± 0.002 Mev. No systematic differences appear between these data and other measurements employing magnetic analysis and other absolute energy calibrations. Data taken on the inelastic scattering of both protons and deuterons from Li^7 result in a value of 0.4780 ± 0.0012 Mev for the first excited level of Li. This figure overlaps previous γ-ray measurements based on the 411.2-kev γ from Au^{198}. The yield of α particles from D bombardment of T_2 absorbed in Zr showed that the number of absorbed T atoms decreased rapidly near the surface of the Zr. From this data, a lower limit of 17.578 ± 0.030 Mev may be given the $T(d,\alpha)n$ Q value. (auth)

4870
Radiation Lab., Univ. of Calif.
STARS PRODUCED IN NUCLEAR EMULSIONS BY CARBON IONS FROM THE CYCLOTRON. James F. Miller. June 14, 1951. 6p. (UCRL-1356)

Preliminary results of the observation of inelastic nuclear events from the collision of C ions with atoms of Ilford E-1 and D-1 nuclear emulsions are discussed. C^{12} and C^{13} ions with respective energies of 120 and 130 Mev have respective ranges in the emulsions of 157 and 190 μ. With C^{12} ions, 102 events have been found out of 181,000 tracks; with C^{13}, 108 events out of 188,000. These correspond to cross sections of 0.40 ± 0.03 barn for C^{12}, 0.37 ± 0.03 barn for C^{13}. A tabulation is made of the number of emergent prongs from the stars. A feature of the stars is the high percentage of α's emerging. Of protons emerging from C stars, the longest track lying wholly in the emulsion was 1046 μ, corresponding to an energy of 14.2 Mev.

4871
ANGULAR DISTRIBUTION OF PROTONS FROM THE D(d,p)T REACTION AT 10.3-MEV BOMBARDING ENERGY. J. C. Allred, D. D. Phillips, and Louis Rosen. Phys. Rev. 82, 782-5(1951) June 15.

The differential cross section of the D(d,p)T reaction for 10.3-Mev bombarding deuterons has been measured by a nuclear emulsion technique, using a multiple nuclear-plate camera. Values of the cross section are given over essentially the entire range of the center-of-mass angle. The results are fitted within experimental error by the expression: $\sigma(\cos\Omega) = 6.24P_0 + 8.82P_2 + 13.16P_4 + 8.24P_6 + 2.31P_8$, where Ω is the center-of-mass angle, σ is expressed in millibarns per unit solid angle, and the P_l's are Legendre polynomials. For angles between 20° and 160° the average rms absolute standard error is ±3.8 per cent. For angles greater than 160° and less than 20° this error approaches ±5 per cent. (auth)

4872
CROSS SECTIONS OF GAMMA-PROTON REACTIONS. J. Halpern and A. K. Mann. Phys. Rev. 83, 370-73(1951) July 15.

Using the University of Pennsylvania betatron, the energy dependences of the $\gamma - p$ cross sections of C, Al, Co, Ni, and Cb have been measured. The cross-section curves exhibit the resonance character found in $\gamma - n$ reactions. The significant parameters of each of the curves are tabulated. From the data of this paper and the known $\gamma - n$ cross-section data, the sum of neutron and proton integrated cross sections is evaluated for carbon and nickel. (auth)

4873
Na^{20} FROM THE GAMMA-RAY BOMBARDMENT OF NaF. R. K. Sheline. Phys. Rev. 82, 954(1951) June 15. (Letter to the editor)

The reaction $Na^{23}(\gamma,3n)Na^{20}$ has been produced using betatron γ rays of 76-Mev maximum energy. The Na^{20} emits a positron to an excited state of Ne^{20} which α decays following the positron half life. The positrons were observed directly in this experiment. The half life of Na^{20} was found to be 0.23 ± 0.08 sec. Because of the low intensity of this second-order reaction it was not possible to measure accurately the energy of the Na^{20} activity. However, using the data of Alvarez (Phys. Rev. 80, 519(1950)), it is possible to put limits on the end point of the positron spectrum of 3.5 to 7.3 Mev.

4874
NEUTRON ENERGY DISTRIBUTION IN PROTON BOMBARDMENT OF Be AND C AT 100 MEV. David Bodansky and Norman F. Ramsey. Phys. Rev. 82, 831-6(1951) June 15.

The energy distributions of neutrons emitted in the forward direction when beryllium and carbon targets are bombarded by 100-Mev protons were investigated. The neutron energy distribution was found from the range distribution of recoil protons from a polyethylene target, measured with a scintillation-counter telescope. The distribution for beryllium was found to be peaked at about 93 Mev, while the distribution for carbon fell off rapidly above 70 Mev. The influence on the observed distribution of energy resolution effects, particularly those involving energy spread of the cyclotron proton beam, is discussed. (auth)

4875
PRODUCTION OF PROTONS BY HIGH ENERGY γ RAYS. C. Levinthal and A. Silverman. Phys. Rev. 82, 822-6(1951) June 15.

The protons ejected from various nuclei by the γ-ray beam of the 320-Mev Berkeley synchrotron have been studied with a proportional-counter telescope system. The energy distribution of the protons from carbon, copper, and lead from 7 to 70 Mev at 90° was roughly proportional to $1/E^2$. The angular distribution was spherically symmetrical for 10-Mev protons and showed a pronounced forward maximum for protons of about 40 Mev. The cross section per nucleus for the ejection of 40-Mev protons was found to be proportional to Z. The experimental results indicate that protons above 30 Mev arise primarily from the interaction of the γ ray with some small subunit of the

nucleus rather than through the formation of an excited compound nucleus. (auth)

4876

PHOTOPROTON EMISSION. A. Lundby and L. Marshall. Phys. Rev. 83, 323-5(1951) July 15.

Protons from (γ,p) reactions produced by betatron bremsstrahlung with a maximum energy of up to 50 Mev have been studied with a scintillation counter telescope. Activation curves in Al and Pb showed threshold and resonance characteristics similar to the corresponding curves for the photoneutron processes. The integrated (γ,p) cross section in Al was found to be $\sim 10^{-28}$ Mev cm^2 for 50 Mev bremsstrahlung. For the eleven elements investigated the integrated cross section was roughly proportional to the atomic number. Absorption studies of the protons revealed a high-energy component extending up to about 20 Mev which amounted to a few per cent of the total number of protons emitted from Al and Pb. For 50 Mev bremsstrahlung the relative photoproton emission at 90° and at 120° to the x-ray beam was measured for Al and Pb. The protons above about 15 Mev were found to come out preferentially at 90° for both elements. (auth)

4877

PHOTOPROTONS FROM MAGNESIUM. M. Elaine Toms and William E. Stephens. Phys. Rev. 82, 709-14(1951) June 1.

The distributions in energy and in angle of the protons ejected from Mg by the bremsstrahlung x rays of a 24-Mev betatron have been observed in nuclear emulsions. Both normal Mg and enriched Mg^{25} show a uniform angular distribution for all proton energies. The energy distribution of the protons from enriched Mg^{25} is compared to the distributions calculated from an evaporation process using various energy level densities. Good agreement is obtained using the known Na^{24} level densities. The integrated cross section of the Mg^{25} (γ,p) reaction is determined as 0.056 ± 0.03 Mev-barn. (auth)

4878

THE THERMAL NEUTRON CAPTURE CROSS SECTION OF Co^{59}. L. Yaffe, R. C. Hawkings, W. F. Merritt, and J. H. Craven. Phys. Rev. 82, 553(1951) May 15. (Letter to the editor)

The activation cross section of Co^{59} for thermal neutrons has been determined using the NRX heavy-water reactor. The Co metal (99.92% pure) was irradiated as a weighed disk 0.3 mm thick. The thermal-neutron capture cross sections for Co^{59} leading to the formation of 5.26-yr Co^{60} and 10.7-min Co^{60m} were found to be 34.2 ± 1.4 and 0.66 barns, respectively. The activation cross section is now in excellent agreement with the results obtained by the "pile oscillator" method (Harris et al., Phys. Rev. 79, 11(1950)).

4879

THE TRANSMUTATION OF N^{14} BY PROTONS. D. B. Duncan and J. E. Perry. Phys. Rev. 82, 809-13(1951) June 15.

Barnett and Brown present, in a recent paper, experimental evidence that supports the theoretical findings of Darwin in an earlier paper; namely, that all metals should have the same effective m/e in acceleration, despite the differences in their Hall coefficients. This paper derives the same conclusion from more elementary premises. (auth)

4880

YIELDS OF PHOTOPROTONS FROM TWENTY ELEMENTS. A. K. Mann and J. Halpern. Phys. Rev. 82, 733-8(1951) June 1.

Scintillation counters have been applied to the study of the yields of photoprotons from 20 elements irradiated with 25-Mev x rays. The relative yields increase by a factor of approximately 100 as Z increases from 4 to 28, and then decrease to a value, at Z = 50, of about one-tenth that of the maximum at Z = 28. An upper limit is placed on the yields from Ta, W, Pt, and Au. The absolute values are compared with the neutron data of Price and Kerst (Phys. Rev. 77, 806(1950)), and the sum of the two yields is compared with theory. (auth)

PARTICLE ACCELERATORS

4881

Radiation Lab., Univ. of California

THE TRANSIENT BEHAVIOR OF A WAVE GUIDE NEAR CUTOFF. Ernest A. Martinelli. Apr. 10, 1951. 7p. (UCRL-1230)

The time scale for the transfer of energy by the propagation of a signal through a wave guide has been investigated. The mathematical analysis used follows the treatment of anomalous dispersion by Sommerfeld (Ann. der Physik 44, 177(1914)) and Brillouin (Ann. der Physik 44, 203(1914)).

4882

Laboratory for Nuclear Science and Engineering., Mass. Inst. of Tech.

DESIGN AND PROPERTIES OF THE M.I.T. LINEAR ELECTRON ACCELERATOR. (Technical Report No. 50) Peter T. Demos. May 1, 1951. 69p. (NP-3230)

The practical design and performance of the MIT linear accelerator are described in detail. The theoretical basis for the design of the MIT machine and for the design of linear accelerators in general is given in references throughout the body of this report. 10 references.

RADIATION ABSORPTION AND SCATTERING

4883

Wisconsin Univ.

PROTON RANGE-ENERGY RELATION FOR EASTMAN NTA EMULSIONS. H. T. Richards, V. R. Johnson, F. Ajzenberg, and M. J. W. Laubenstein. [nd] 6p. (AECU-1351)

A range-energy curve for 1- to 16-Mev protons stopped in Eastman NTA emulsions using the proton recoils from the neutrons given by reactions $Li^7(p,n)Be^7$, $Be^9(p,n)B^9$, $Be^9(d,n)B^{10}$, $B^{10}(d,n)C^{11}$, $B^{11}(d,n)C^{12}$, and $O^{18}(d,n)F^{17}$ for calibration points, is described and compared with the range-energy curve calculated by Webb (Phys. Rev. 74, 511(1948)). Calculated and observed range-energy curves agree satisfactorily.

4884

Wisconsin Univ.

THE ELASTIC SCATTERING OF PROTONS BY Mg^{24}. (abstract) F. P. Mooring, E. Goldberg, S. G. Kaufmann, L. J. Koester, and D. Saxon. [nd] 1p. (AECU-1371)

This report is reproduced here in its entirety.

Protons from the electrostatic generator were used to bombard thin $Mg^{24}F_2$ targets evaporated onto spectroscopically pure graphite backings, and the elastically scattered protons were observed at a laboratory angle of 164 ± 5°. A 90° magnetic analyzer separated the proton groups, and a proportional counter distinguished between proton pulses and fluorine alpha pulses. The elastic differential scattering cross section curve for incident proton energies of 0.396 to 3.936 Mev shows nine levels of the compound nucleus Al^{25}. The level reported by Grotdal et al. (Phys. Rev. 77, 296(1950)) for 0.417-Mev protons was not observed. The elastic scattering yield below 0.8 Mev was assumed to be Rutherford, and was used to determine differential scattering-cross-section values.

4885

Brookhaven National Lab.

CALCULATIONS CONCERNING THE MEASUREMENT OF THE ENERGY OF CHARGED PARTICLES BY SMALL

ANGLE SCATTERING. Hartland S. Snyder. June 20, 1951. 4p. (AECU-1498)

For the papers by Snyder and Scott (Phys. Rev. 76, 220(1949)) and Scott and Snyder (ibid. 78, 223(1950)) various tables of functions have been computed, and relations have been determined from which can be found relationships among the mean angle between successive chords on a track in a nuclear emulsion; the momentum of the charged particle; the velocity, v, of the particle; the chord length, s; and the composition of the matter through which the particle is passing. A plot is given of the scattering constant K vs. $S/\left(\frac{v}{c}\right)^2$.

4886

Wisconsin Univ.

THE ELASTIC SCATTERING AND CAPTURE OF PROTONS BY OXYGEN. R. A. Laubenstein, M. J. W. Laubenstein, L. J. Koester, and R. C. Mobley. [nd] 30p. (AECU-1510)

The yield of elastically scattered protons from oxygen was measured with a magnetic analyzer which detected protons scattered through laboratory angles of 159 to 169°. Using protons accelerated by an electrostatic generator, the proton energy range from 0.6 to 4.5 Mev was covered. Two sharp resonances were observed, one at an incident proton energy of 2.66 Mev with a width of 19.9 kev, and the second at 3.47 Mev with a width <3.5 kev. Near 4.0 Mev a broad maximum in the cross section was obtained, and a broad resonance appears to give another maximum slightly above 4.5 Mev. The resonance at 2.66 Mev appeared as a nearly symmetrical dip in the scattering cross section. The capture cross section of oxygen for protons was measured for incident proton energies from 1.4 to 4.1 Mev by counting the positrons from the decay of F^{17} built up under the bombardment of oxide targets. Up to a narrow resonance at 3.47 Mev the capture cross section increased almost linearly with energy. Above 3.75 Mev the cross section was found to increase more rapidly to a maximum near 3.99 Mev. On the basis of the scattering and capture data, energy levels have been assigned to F^{17} at 3.11, 3.88, 4.36, and 4.73 Mev, although the positions of the latter two levels are not clearly defined by the data. (auth)

4887

Rochester Univ.

ELASTIC PROTON-DEUTERON SCATTERING AT 240 MEV. R. D. Schamberger. July 5, 1951. 4p. (NYO-900)

The elastic proton-deuteron differential scattering cross section at 240 Mev has been measured for proton scattering angles from 20.5 to 100° in the center-of-mass system. When the internal proton beam of the Rochester synchrocyclotron struck a thin target of heavy paraffin, coincidences were observed between the scattered proton and recoil deuteron using scintillation counters and conventional electronics. The incident beam was determined from the C^{11} β activity of the target produced by the reaction $C^{12}(p,pn)C^{11}$. Experimental values of the cross section are plotted.

4888

Radiation Lab., Univ. of California

SUMMARY OF THE RESEARCH PROGRESS MEETING OF NOVEMBER 30, 1950. Margaret Foss Folden. Apr. 6, 1951. 14p. (UCRL-1235)

Protons Scattered out of Nuclei at High Energy. A 35-channel magnetic particle spectrometer has been used in the cave of the 184-in. cyclotron to obtain energy spectra of protons scattered at 22° from H, D, C, and O. The scattered protons enter the slit counter and traverse three large proportional counters and the bank of 35 G-M tubes. All the peaks fall at nearly the same energy, the energy expected for proton-proton collision. The half-widths of the curves are 70 Mev for H, 110 Mev for D, and 130 Mev for C and O. Proton-Helium Scattering. This experiment was done at the 60-in. cyclotron with the Los Alamos multiplate camera. The work was completed in 36 hr with this equipment which was devised to obtain a great deal of data with a small amount of running time. A schematic of the camera and the cyclotron, photographs of the scattering chamber (which was filled with He), and a plot of differential cross section per unit solid angle as a function of center-of-mass angle are shown. Production of Positive Mesons by Protons as a Function of Z. The energy distribution of π^+ mesons produced by synchrotron protons on He has been measured at angles of 45, 90, and 135°. The experimental arrangement is shown. Graphs show the π^+ meson energy spectrum of protons on polyethylene and the yield relative to number of protons and nuclei of 53-Mev π^+ mesons as a function of Z. 10 figures.

4889

Radiation Lab., Univ. of Calif.

ELASTIC SCATTERING OF 340 MEV PROTONS. R. E. Richardson, Wm. P. Ball, C. E. Leith, and B. J. Moyer. May 9, 1951. 8p. (UCRL-1284)

The de Broglie wavelength of 340-Mev protons is appreciably less than nuclear radii, and because of this it is possible to observe a greater portion of the Fraunhofer diffraction pattern than has hitherto been observed. Incident protons were provided by the external beam of the 184-in. synchrocyclotron, removed from the orbit by scattering into a magnetic deflecting channel. Scattered protons were detected by a triple-coincidence, scintillation-counter telescope placed 48 in. from a thin scatterer. Coincidences were observed in a circuit of approximately 2×10^{-8} sec resolving time. Scattering curves (diffraction patterns) in the laboratory system are presented for C, Al, S, Cu, and Pb.

4890

Radiation Lab., Univ. of California

THE PASSAGE OF CHARGED PARTICLES THROUGH MATTER. (thesis) Walter Arthur Aron. May 1951. 47p. (UCRL-1325)

Calculations concerned with the passage of protons through H, He, Li, Be, C, Al, A, Cu, Ag, and Pb are presented. In the range of energies considered (1 to 10,000 Mev) processes other than ionization and excitation of the atoms of the material seldom occur, and only these processes have been taken into account. The rate of energy loss and the range of protons has been calculated as a function of energy, in an attempt to get a good fit to new experimental data. It is believed that above 10 Mev the ranges are good to 0.5%. Below 10 Mev the range is increasingly more sensitive to errors in the initial ranges. The rate of energy loss is believed to be good to 0.5% down to about 5 Mev. From comparisons of preliminary calculations with experimental values a better value of the mean excitation potential was obtained, and the final results were calculated with these improved values.

4891

California Univ.

MULTIPLE SCATTERING IN A SEMI-INFINITE MEDIUM. (thesis) John W. Weymouth. June 20, 1951. 35p. (UCRL-1333)

The solution of the Boltzmann equation in the presence of boundaries has been studied in order to gain information on the backscattering of charged particles. In particular, the multiple scattering in a semi-infinite medium was examined. The general method for solution of the Boltzmann equation in a semi-infinite medium is outlined. The problem is solved for a uniform distribution of spherically sym-

metric sources and the flux at the surface is calculated. An estimation is made of the correction due to the variation of the cross section with velocity. This corrected flux is applied to an experimental example of the energy spectrum of a thick source of electron emitters.

4892

NUCLEAR GAMMA-ABSORPTION CROSS SECTION OF Cu^{63}. L. Marshall, A. H. Rosenfeld, and S. C. Wright. Phys. Rev. 83, 305-7(1951) July 15.

The absolute intensity of the bremsstrahlung beam from 46-Mev electrons in the Chicago betatron has been determined. Copper foil was irradiated and its activity measured with a calibrated counter. The integrated cross section for $Cu^{63}(\gamma,n)Cu^{62}$ was found to be $(0.77 \pm 0.15) \times 10^{-24}$ cm² Mev. A Victoreen thimble surrounded by a ¼ in.-thick lead wall and inserted into the beam, measured 1 r/min for every 2.5×10^{7} Mev cm^{-2} sec^{-1} of beam intensity. (auth)

4893

DIFFUSION OF HIGH ENERGY GAMMA-RAYS THROUGH MATTER. III. REFINEMENT OF THE SOLUTION OF THE DIFFUSION EQUATION. L. L. Foldy. Phys. Rev. 82, 927-31(1951) June 15.

In Part I of the present series of papers an approximate equation was derived governing the diffusion of high energy gamma-rays through matter. In Part II an approximate solution of this diffusion equation was obtained in the energy region where the total gamma-ray cross section was substantially independent of energy. In the present paper, by consideration of the methods employed in obtaining the solution in II, a refinement of the solution is carried out which reduces the errors introduced by the approximations made both in the energy distribution and the angular distribution of the multiply-scattered gamma-rays. The solution is also modified to take into partial account the effect of small variations of the total gamma-ray cross section with energy. An upper and lower bound on the solution is obtained when the cross section is independent of energy. (auth)

4894

ON THE SCATTERING OF A PARTICLE BY A STATIC POTENTIAL. R. Jost and A. Pais. Phys. Rev. 82, 840-5(1951) June 15.

The behavior of the solutions of scattering integral equations is studied as a function of the potential strength λ. From an analysis of the second Born approximation for a Yukawa potential it seems indicated that the Born expansion for a nuclear potential has no useful domain of applicability. The convergence of the Born expansion is discussed. It is shown that the Fredholm theory of integral equations enables one to express the solutions as a quotient of infinite power series in λ which still converge when the Born expansion breaks down. Only in exceptional cases can this method be used for obtaining rapid numerical estimates. (auth)

4895

ON THE SCATTERING OF SLOW NEUTRONS BY THE CRYSTAL LATTICE OF ALLOYS OF ARBITRARY COMPOSITION UNDERGOING ORDERING PROCESSES. A. A. Smirnov and B. V. Paducevh. Zhur. Eksptl'. i Teoret. Fiz. 21, 541-6(1951) Apr. (In Russian)

The problem of scattering of slow neutrons by the lattice of alloys undergoing ordering processes has been discussed by Smirnov and Vonsovskiĭ (J. Physics U.S.S.R. 5, 263(1941)) for the case of stoichiometric compositions of the alloy. The case of an arbitrary composition is examined here in a theoretical study on the effect of the composition and of the degree of remoteness of the ordering on the scattering of slow neutrons.

4896

SCATTERING OF SECONDARY ELECTRONS PRODUCED BY γ-RAYS IN MATERIALS OF VARIOUS ATOMIC NUMBERS. Gerald J. Hine. Phys. Rev. 82, 755-6(1951) June 1. (Letter to the editor)

The scattering of secondary electrons produced by monochromatic γ rays in materials of various Z has been studied as a function of the γ-ray energy. A collimated beam of γ rays from various radioisotopes was passed through two adjacent ionization chambers with absorbers placed vertically between them. Backscattered secondary electrons produced by γ rays in the absorber were observed in the first chamber, while the emergent electrons increased the ion current in the second chamber. Results obtained with seven nuclides are shown on three graphs. For Al and Cu absorbers, the ratio of forward to backward emission increases rapidly with increasing γ-ray energy. Pb, however, emits about equal amounts of secondary electrons in both directions rather independent of the γ-ray energy.

4897

THE SHAPE OF RESONANCE SCATTERING LINES OF α PARTICLES. H. Marschall and D. Wiskott. Z. Physik 129, 619-25(1951) May 17. (In German)

Supplementing a recently outlined theory of the anomalous scattering of α particles (Marschall, Z. Physik 128, 635(1950)) in which the anomaly is calculated as a function of the scattering angle for a given resonance energy, the present paper shows how the dependence of the anomaly on the α energy, an element required in a complete description of the anomalous scattering, can be determined by means of a simple graphical procedure. With changing scattering angle, large changes in the shape of a given resonance line take place. The graphical method furnishes an easy survey of curve shapes to be expected at various scattering angles. (auth)

RADIATION EFFECTS

4898

THE EFFECT OF FAST NEUTRON BOMBARDMENT ON THE ELECTRICAL PROPERTIES OF GERMANIUM. J. W. Cleland, J. H. Crawford, Jr., K. Lark-Horovitz, J. C. Pigg, and F. W. Young, Jr. Phys. Rev. 83, 312-19 (1951) July 15.

Lattice disorder in bulk Ge produced by collisions of fast neutrons with lattice atoms introduces a net excess of electron traps or acceptor states, which appear to have an energy distribution in the forbidden band. Bombardment of N-type Ge causes the conductivity to decrease, initially at a uniform rate, to a minimum value and then to increase. Examination of the data shows that initially about 3.2 conduction electrons are removed per incident fast neutron. The minimum value of the conductivity is higher than the value calculated assuming complete homogeneity and thermal equilibrium. Hall effect measurements prove that after the minimum is passed the material has been converted to P-type by fast neutron bombardment. The conductivity of P-type Ge increases with bombardment. The rate of increase decreases monotonically indicating an approach to saturation. The initial rate of carrier introduction in P-type Ge appears to be temperature dependent, being greater at higher temperatures (~0.8 carrier per incident neutron at 30°C), and smaller than the rate of carrier removal for N-type Ge which is apparently temperature independent in the temperature range investigated (−79°C to 45°C). The effect of lattice disordering on the electrical properties of Ge may be removed by careful vacuum annealing at 450°C while a portion of this effect readily anneals at room temperature. (auth)

4899
THE EFFECT OF OXYGEN ON MUTATION INDUCTION BY X-RAYS. Edward H. Anderson. Proc. Natl. Acad. Sci. U.S. 37, 340-49(1951) June.

The effect of a high oxygen tension on the induction of mutations by x rays has been examined for a streptomycin-dependent strain and for a purineless strain of E. coli. Back-mutation rates to streptomycin nondependence and purine nondependence were studied under comparative exposures to x rays in the presence of oxygen and of nitrogen. The sensitivity of both strains to the lethal effects of x rays was similarily increased by the presence of oxygen during irradiation. Mutation rates of both strains were increased with length of exposure to x rays in the presence of either oxygen or nitrogen. Oxygen was found to have but slight additional effect over nitrogen on x-ray induction of back mutations in the streptomycin-dependent strain. On the other hand the back-mutation rate of the purine-dependent strain was found to be profoundly increased by the presence of oxygen during irradiation. The dose-reduction value of oxygen for the genetic effect for this strain is the same as that for the lethal effect. This is interpreted as an indication that the same mechanisms are involved in the lethal and this specific genetic effect of x rays in the purineless strain. Different mechanisms appear to be involved in these two effects of x rays on the streptomycin-dependent strain. (auth)

4900
EFFECT OF WEAK BETAS ON THE BREAKDOWN OF DIELECTRIC GAPS. Jerome J. Suran. Nucleonics 8, No. 6, 34-5(1951) June.

The effect of β radiation of 2500 mr/hr (at 1-in. air range) on the breakdown characteristics of several dielectrics was investigated. A 0.65-Mev Sr^{90} and 2.16-Mev Y^{90} mixture on gold foil served as the β source. The electrode geometry used is diagrammed and results for air gaps are tabulated. An optimum air gap length exists, which in these experiments is approximately 80 mils, corresponding to the normal breakdown voltage of 3,400 volts d-c, where the reduction in breakdown voltage is most pronounced. As gap size is increased above an optimum value, the effective ionization per unit volume of dielectric apparently approache a constant. For a-c voltages of 60-cycle frequency, the radiation effect upon dielectric breakdown characteristics is approximately the same as that for a d-c potential.

RADIOACTIVITY

4901
Brookhaven National Lab.
THE RADIOACTIVE DECAY OF Ca^{41}. V. L. Sailor and J. J. Floyd. Apr. 16, 1951. 7p. (AECU-1388)

By means of a proportional-counter x-ray spectrometer, x rays due to Ca^{41} decay have been studied. The appearance of a 3.40 ± 0.15-kev x ray, corresponding to the potassium K_α x ray of 3.31 kev, indicates that Ca^{41} decays by electron capture to K^{41} with a half life of the order of months or years.

4902
Purdue Univ.
DUAL DECAY OF THE 50-d In^{114} ISOMER AND ANGULAR MOMENTA OF THE EXCITED STATES OF Cd^{114}. Rolf M. Steffen. [nd] 5p. (AECU-1431)

In order to decide whether the K-capture decay observed in In^{114} arises from the 50-day isomeric state of this nuclide, the angular momenta of the two excited states of Cd^{114} have been investigated by measuring the angular correlation of the two successively emitted γ rays. Angular momenta of 0, 2, and 4 are assigned to the Cd^{114} ground and first and second excited states, respectively. Final parity assignments to the Cd^{114} levels will be made by polarization-correlation experiments now in progress. Measurements of the conversion of the 0.192-Mev isomeric transition of In^{114} lead to the conclusion that the 50-day level has an angular momentum of 5, even parity, and decays to the 1.26-Mev level of Cd^{114} by K capture.

4903
Wisconsin Univ.
A NOTE ON THE BETA-DECAY OF F^{17}. H. T. Richards. [nd] 5p. (AECU-1500)

Consideration is given to the apparent contradiction between current level classifications and the unusually low ft value (350 sec) for the 33 ± 5% branching to the first excited state of O^{17} in the β decay of F^{17}, as observed by Perez-Mendez and Lindenfeld (Phys. Rev. 80, 1097(1951)). Both the level classifications and the evidence for the β-ray branching are reviewed, and the possibility that the reported low-energy positron may have originated in a contaminating activity is considered. It is concluded that more measurements on the radioactivity of F^{17} must be made before the contradiction can be explained.

4904
Brookhaven National Lab.
THE DECAY SCHEME OF Cu^{66}. G. Friedlander and D. E. Alburger. [nd] 19p. (AECU-1512)

The decay scheme of 5.2-min Cu^{66} has been determined by β-ray spectrometer, scintillation spectrometer and coincidence measurements. Of the β ray transitions 9.2 ± 1% go to an excited state of Zn^{66} whose lifetime is less than 10^{-7} sec and are followed by 1.044 ± 0.010-Mev γ rays. The remaining 91% of the β decays go to the ground state of Zn^{66}, with an upper energy limit of 2.63 ± 0.02 Mev. This high-energy β group appears to have the allowed spectrum shape. Both β decays have ft values characteristic of allowed transitions. Spin and parity assignments for Cu^{66} and for the 1.044-Mev level of Zn^{66} are made and some features of the decay of Ga^{66} to Zn^{66} are discussed. (auth)

4905
Oak Ridge National Lab.
A NOTE ON ISOTROPY IN NUCLEAR GAMMA RADIATION. G. B. Arfken, L. C. Biedenharn, and M. E. Rose. May 29, 1951. 12p. (ORNL-1018)

Consideration is given to the decay of a compound nuclear state by two or more competing processes in which the competing radiations are γ rays and/or α particles (or in general spinless particles). If one of the γ radiations is observed to be isotropic, circumstances under which competing radiations will also exhibit isotropy are discussed. It is concluded that if one has isotropic 2^L-pole gamma radiation from a state j_1 to a state j_2 and $L \geq j_1 - \frac{1}{2}$, then all radiation from j_1 will be isotropic. This has been proved for cases of physical interest for $j_2 \leq 2$ with one exception, $j_1 = j_2 = \frac{3}{2}$, $L = 2$, which is of possible interest in the transition $Li^{7*}(\gamma)Li^7$.

4906
Oak Ridge National Lab.
THE EFFECT OF THE FINITE SIZE OF THE NUCLEUS IN β-DECAY. M. E. Rose and D. K. Holmes. June 15,1951. 26p. (ORNL-1022)

The energy distribution of the emitted particles in allowed and forbidden β transitions has usually been expressed by relativistic Coulomb wave functions evaluated at the nuclear radius. The present work was undertaken to determine the magnitude of the corrections introduced by calculating the electronic wave functions in a potential which takes into account the finite size of the nucleus. The results indicate that the corrections for the finite nuclear size will affect the shape of the β spectrum significantly only for n^{th} forbidden transitions ($n \geq 2$) and for spin change equal to the

order of forbiddenness (unfavorable parity change in the case of Gamow-Teller interactions). The only well-investigated case for which the finite-size correction should be important is the RaE spectrum. Eight plots present the correction factors as functions of the electron or positron energy.

4907

California Univ.

THE SPECTROMETRIC DETERMINATION OF SOME BETA PARTICLE AND CONVERSION ELECTRON ENERGIES. (thesis) Grover Davis O'Kelley. Mar. 15, 1951. 97p. (UCRL-1243)

A double-focusing beta spectrometer having a radius of 25 cm has been constructed. The theoretical transmission for a resolving power of 1½% is about 1% of 4π. The spectrometer and auxiliary equipment are described. The decay of Am^{242} has been investigated, using the β spectrometer, and a decay scheme is postulated. Schemes are also proposed for the decay of Am^{241}, Cm^{242}, Np^{236}, and Pb^{203}. The radiations of the heavy nuclides Np^{234}, Pu^{243}, Pu^{238}, Pb^{209}, and Pb^{200} have also been measured. The radiations from neutron-deficient isotopes of Zr and their decay products have been determined, and a decay scheme is postulated for the decay of Zr^{87}. 74 references. 35 figures. (auth)

4908

THE APPLICATION OF PROPORTIONAL SCINTILLATION γ-RAY COUNTERS TO THE DETERMINATION OF THE DECAY SCHEME OF Au^{198}. Patrick E. Cavanagh. Phys. Rev. 82, 791-5(1951) June 15.

Besides the main γ ray at 0.411 Mev, Au^{198} also emits two higher-energy γ rays of energy 0.67 and 1.09 Mev, present to the extent of only 1.4 and 0.4 per cent, respectively. Using large clear blocks of naphthalene + 1 per cent anthracene as crude γ-ray separators, it has been established, by coincidence absorption measurements, that the high-energy γ-rays are in coincidence with β rays of maximum energy 295 kev. Moreover, it has been established that γ−γ coincidences also occur, and that the 0.67-Mev γ ray is in cascade with the 0.411-Mev γ ray. The 1.09-Mev γ ray is not in coincidence with either of the others. By comparing the γ−γ-coincidence rate and the β−γ-coincidence rate taken under appropriate conditions, it was possible to determine branching ratios for the 0.67- and 1.09-Mev γ rays. These are (1.43 ± 0.10) per cent, (0.33 ± 0.07) per cent, respectively, these results being in excellent agreement with those derived from spectrometer measurements. The β−γ- and γ−γ-coincidence measurements establish that Hg^{198} has energy levels at 0.411 and 1.09 Mev. (auth)

4909

CLOUD-CHAMBER INVESTIGATIONS OF XENON ISOTOPES Xe^{133} AND Xe^{135}. Heinz Behrens. Z. Naturforsch. 6a, 249-51(1951) May. (In German)

Beta-active Xe^{133} and Xe^{135}, formed as secondary products of U fission, were studied in a cloud chamber. The γ radiation which accompanies the β decay was measured by means of "internal conversion" electrons: Xe^{133} emits a 77 ± 15-kev quantum while Xe^{135} emits rays of 53 ± 10, 148 ± 15, 190 ± 19, and 261 ± 26 kev; the 190-kev emission can probably take place in two steps. A few typical photographs of such "internal conversions," observed as single events, are shown. (auth)

4910

COINCIDENCE MEASUREMENTS OF β AND γ RADIATIONS OF Cu^{64}. Süreyya Meriç. Rev. faculté sci. univ. Istanbul 16, 51-69(1951) Jan.

Using β−γ coincidences, the author investigates the question of whether the γ radiation of Cu^{64} is of nuclear origin or is due to pair annihilation. Within statistical errors, a correlation was observed between β^+ and γ radiations; no correlation was found to exist between the coincidence rate and the energy of β^+ particles. It is concluded that the radiation originates in the nucleus.

4911

THE ENERGY OF THE GAMMA-RAY FROM Se^{77m}. Robert Canada, W. H. Cuffey, A. E. Lessor, and Allan C. G. Mitchell. Phys. Rev. 82, 750(1951) June 1. (Letter to the editor)

During an investigation of Br^{77}, a very weak γ ray of 160 kev was found in the photoelectric spectrum, and a very strong internal conversion line corresponding to the same γ ray was found in the particle spectrum. Experiments were performed to see whether a Se activity was growing from the Br^{77}. To a solution containing activated Br^{77} ion there was added a small amount of SeO_3^{--}. The SeO_3^{--} was reduced to Se metal by the addition of stannous chloride. The decay curve of the resulting Se^{77m} yields a half life of 17.5 sec, with a probable error of about 10%. The energy of the γ ray associated with the transition to the ground state of Se^{77} is 159.9 ± 1.0 kev.

4912

FORBIDDEN BETA-RAY SPECTRA. A. M. Smith. Phys. Rev. 82, 955-6(1951) June 15. (Letter to the editor)

Recent developments in the study of shapes of forbidden beta-ray spectra have indicated that the interaction responsible for β decay may involve some linear combination of the five relativistically invariant forms which have hitherto been used (E. J. Konopinski and G. E. Uhlenbeck, Phys. Rev. 60, 308(1941)). In view of this, the cross correction factors for first- and second-forbidden transitions, which arise due to squaring of terms in the interaction, have been worked out and are given.

4913

GAMMA-RAYS EMITTED IN THE DISINTEGRATION OF THE 36-HOUR Rh^{105}. C. E. Mandeville and E. Shapiro. Phys. Rev. 82, 953-4(1951) June 15. (Letter to the editor)

Observations by Duffield and Langer (Phys. Rev. 81, 203(1951)) on the 36-hr Rh^{105} activity failed to disclose any evidence of the γ ray at ~0.3 Mev reported by the authors (Phys. Rev. 80, 125(1950)). Therefore, the radiations have been reexamined. The preparation of the Rh^{105} and the setup of the experiment are described. The 0.3-Mev γ rays observed were carefully studied to be sure their presence could not be accounted for by bremsstrahlung effects. It is concluded that γ rays are present in the disintegration of Rh^{105}, and from the coincidence observations it is estimated that the 0.3-Mev γ ray accompanies ~8% of the β rays.

4914

HALF-LIVES OF SOME RADIOACTIVE ISOTOPES. W. K. Sinclair and A. F. Holloway. Nature 167, 365(1951) Mar. 3. (Letter to the editor)

An anomalous rate of decay has been observed for P^{32} as Na_2HPO_4 in solution. A mold on which the activity appeared to concentrate sometimes formed in the solution. The activity of the solution usually appeared to decay more rapidly than the normal half life of P^{32}. Also P^{32} incorporated as red P in polythene plastic appeared to exude phosphoric acid when prepared by calendering. Apparent half lives as short as 8 days have been observed for P^{32} in this form. Results are tabulated of measurements of the half lives of K^{42}, Na^{24}, Br^{82}, Au^{198}, I^{131}, P^{32}, Ir^{192}, Ta^{182}, and Co^{60} in various types of sources.

4915

HIGHLY FORBIDDEN TRANSITIONS IN THE DECAY OF Na^{24}. J. F. Turner and P. E. Cavanagh. Phil. Mag. 42 636-41(1951) June.

A description is given of the use of an organic scintillation counter in conjunction with a thin-lens β spectrom-

eter to detect low-intensity, high-energy electron groups in the presence of a high background. Evidence for a 4.17-Mev β-group in the radiations from Na^{24} has been found, and a value of branching-ratio obtained. Measurements made on the secondary electron spectrum from Na^{24} show the presence of a high energy γ-ray possibly from the cross-over γ-transition in Mg^{24}. (auth)

4916

ORBITAL PERTURBATION EFFECTS IN BETA-DECAY. H. M. Schwartz and R. R. Edwards. J. Chem. Phys. 19, 385-6(1951) Mar. (Letter to the editor)

The degree of internal ionization in the atom associated with β decay is being investigated theoretically and experimentally. Two possible causes (A. Migdal, J. Phys. (U.S.S.R. 4, 449(1951); E. L. Feinberg, ibid. 4, 423(1941)) are mentioned. A third source of energy for atomic excitation and ionization in heavy atoms is the excess atomic binding energy which is liberated in a β^- decay. Attention is called to the possibilities of experimental investigation of the disposition of the excess binding energy.

4917

RADIATIONS OF Ag^{110}. Max Goodrich. Phys. Rev. 82, 759-60(1951) June 1. (Letter to the editor)

Using a scintillation spectrometer, direct measurement of the spectrum of the short-lived radiations of Ag^{110} has been made with the fast pneumatic tube installed at the Oak Ridge graphite reactor. Confirmation of Siegbahn's (Phys. Rev. 77, 233(1950)) assignment of the 24-sec period to the ground state has been found. The β spectrum is complex and has been found by Fermi analysis to contain components having end points of 2.82 ± 0.1 and 2.24 ± 0.1 Mev. The lower energy β ray constitutes the larger fraction (60 to 70%) of the total β-ray activity. The γ spectrum shows a relatively strong line at 0.66 ± 0.02 Mev, a very much weaker line at about 0.9 Mev, and a suggestion of other extremely weak lines. The presence of a γ ray at about 0.9 Mev indicates that the spectrum contains a weak component going to one of the upper levels of Cd^{110}.

4918

RADIOACTIVE DECAY OF Cs^{137}. M. A. Waggoner. Phys. Rev. 82, 906-9(1951) June 15.

The spins of the ground states of Cs^{137} and Ba^{137} are known to be 7/2 and 3/2, respectively. The shape of the 518-kev beta-ray spectrum has been measured and found to correspond to the correction factor $G' = (W_0 - W)^2 + A(W^2 - 1)$ in agreement with previous work. This is the shape predicted by the Fermi theory of beta-ray decay and the Gamow-Teller selection rules for a transition for which $\Delta I = \pm 2$ and there is a parity change. The internal conversion coefficient of the 663-kev gamma-ray has been measured and found to be 0.097, which is in agreement with the theoretical value for magnetic 2^4-pole radiation. (auth)

SPECTROSCOPY

4919

ANALYSIS OF THE 774 $cm^{-1}(\nu_6)$ ABSORPTION BAND OF F_2CO. Alvin H. Nielsen. J. Chem. Phys. 19, 98-100(1951) Jan.

The absorption band at 774 cm^{-1} in F_2CO, which has the appearance of a parallel-type band for a symmetric top, has been resolved into its rotational fine structure with a grating. An analysis of the band has been performed and reveals the band center to be 774.40 cm^{-1} and the average B'' for the two close moments of inertia to be 0.3925 cm^{-1}. The moments of inertia in the upper and lower states are very nearly identical and the coefficient of the $(\nu_6 + \frac{1}{2})^2$ term in the energy is estimated to be 1.4 cm^{-1}. (auth)

4920

A MULTIPLIER PHOTOCELL ATTACHMENT FOR USE WITH PRISM SPECTROGRAPHS. J. M. Naish. J. Sci. Instruments 28, 138-40(1951) May.

A photoelectric adapter is described for making measurements of spectral line intensities in the visible and ultraviolet regions. Two integral multiplier photocell units are mounted in a modified spectrograph plate-holder, and provide outputs proportional to the intensities in two selected wavelengths. The outputs may be compared visually or photographically by oscillographic techniques, or may be measured by an integrator circuit. Details are given of the light-tight construction of the units, the system of rapid and accurate line location, the focus adjustment, and the slit mechanism. The performance is treated theoretically by considering the possible resolution, sensitivity, and precision of wavelength location. The experimental resolution obtained is 1.5 A at 3000 A. (auth)

4921

ULTRAVIOLET ABSORPTION SPECTRUM OF GASEOUS HYDROGEN FLUORIDE. E. Safary, J. Romand, and B. Vodar. J. Chem. Phys. 19, 379-80(1951) Mar. (Letter to editor)

The absorption spectrum of gaseous hydrogen fluoride has been investigated down to 1500 A and that of liquid hydrogen fluoride down to 2200 A. There are no discrete bands in the whole spectrum down to the lowest λ investigated. Absorption increases when the gas is heated. Two alternative interpretations of the results in terms of association are suggested.

THEORETICAL PHYSICS

4922

ACTION AS A SPACE COORDINATE. PART 4. Yu B. Rumer. Zhur. Eksptl'. i Teoret. Fiz. 21, 454-61(1951) Mar. (In Russian)

Previous parts of this work on a 5-optics that furnishes a unified theory of gravitational and electromagnetic fields appeared in Zhur. Eksptl'. i Teoret. Fiz. 19, 86, 207, 868(1949), (see Nuclear Science Abstracts, abstracts 4-1272, 1273, 1274). In the present paper a quantum theory of a weak 5-field in a vacuum is given. It is found that this theory is a generalization of the quantum electrodynamics. (auth)

4923

ADIABATIC FORM OF THE PERTURBATION THEORY IN THE PROBLEM OF THE INTERACTION BETWEEN A PARTICLE AND A QUANTIZED FIELD. S. V. Tyablikov Zhur. Eksptl'. i Teoret. Fiz. 21, 377-88(1951) Mar. (In Russian)

The adiabatic form of the perturbation theory, developed by Born et al. (Ann. Physik 84, 457(1927)), has been applied by Bogolyubov and Tyablikov (Zhur. Eksptl'. i Teoret. Fiz. 19, 256(1949); Vestnik Mosk. Gosud. Univ., No. 3(1949)) to the case of an "adiabatic coupling" between a particle and a field, in which the kinetic energy of the field oscillators plays the role of the small perturbation to be considered. (It can be noted that such a case is closely related to that of a strong coupling examined in the meson theory of nuclear forces.) In the present paper a new form is given to that theory by taking into account the translational degeneration in the interaction between a particle and a field. As an example, the Hamiltonian of the electron in an ionic crystal is considered.

4924

A COMPARISON OF THE SPECTRA OF THE OPERATORS H_1 AND $-(h/2\pi i)(\partial/\partial t)$. Olivier Costa de Beauregard. Compt. rend. 232, 308-10(1951) Jan. 22. (In French)

A discussion in physical terms of the eigenfunctions of the quadrioperator previously defined by the author (Compt. rend. 232, 214-16(1951)) and a comparison with those of the Hamiltonian are presented.

4925
ON THE INTERPRETATION OF REGULARIZATION PROCEDURES IN QUANTUM ELECTRODYNAMICS. D. Ivanenko and V. Grigoriev. Zhur. Ekspti'. i Teoret. Fiz. 21, 563-6(1951) Apr. (Letter to editor; in Russian)

Attempts at eliminating divergences in the modern quantum theory are usually considered as either "realistic" (search for physically-real compensating fields) or "formalistic" (search for a special mathematical formalism). Such distinctions are not logically justified. It is shown that Feynman's regularization formalism does not eliminate the infinite energy of zero oscillations of the free field, and that it should probably be possible to eliminate this zero-order energy by introducing "auxiliary" fields of half-integer spin. It follows that the "formalism" examined must be complemented by a definite physical interpretation.

4926
RADIATION CORRECTIONS IN THE PROBLEM OF THE SCATTERING OF AN ELECTRON IN AN ELECTROMAGNETIC FIELD. A. A. Abrikosov and I. M. Khalatnikov. Zhur. Ekspti'. i Teoret. Fiz. 21, 429-35(1951) Mar. (In Russian)

A relativistically-invariant method of calculation of radiation corrections (in the approximation e^2/hc) for an interaction between an electron and an external field is given. The principal expressions are formulated for arbitrarily large fields. For the elimination of infinite terms not corresponding to observed effects, a procedure involving cut-off factors of a very general type is introduced. (auth)

4927
RESTRICTION OF POSSIBLE INTERACTIONS IN QUANTUM ELECTRODYNAMICS. A. Petermann and E. C. G. Stueckelberg. Phys. Rev. 82, 548-9(1951) May 15. (Letter to the editor)

It can be shown that the integral method of collision theory (Stueckelberg and Rivier, Helv. Phys. Acta 23, 216(1950)) permits the development of a unitary and causal S-matrix in terms of one or more scalar and hermitian local interaction densities. In order to avoid the introduction of an infinite number of interaction densities, a necessary and sufficient condition is given for the formal substitution of "effective" causal functions and "effective" coupling operators for the true functions and operators.

4928
THE THEORY OF INTERNAL CONVERSION. N. Tralli and G. Goertzel. Phys. Rev. 83, 399-404(1951) July 15

The theory of the internal conversion process is presented on a firm quantum-mechanical foundation and in a form most convenient for calculations. The question of the correct gauge for the radiation potentials and the effect of the finite size of the nucleus on these potentials are considered. (auth)

4929
A VARIATIONAL METHOD FOR INELASTIC COLLISION PROBLEMS. B. L. Moiseiwitsch. Phys. Rev. 82, 753(1951) June 1. (Letter to the editor)

A generalization of Hulthèn's variational method to the inelastic scattering of electrons by atoms has been derived using the integral $L = \int \psi^* (H-E)\psi \, d\tau$, where H is the Hamiltonian of the system. The variational method outlined can be extended to include any order partial wave and excitation to any state of the atom.

TRITIUM AND TRITIUM COMPOUNDS

4930
Rochester Univ. and Columbia Univ.
π^- MESON REACTIONS IN TRITIUM. A. M. L. Messiah, E. Caianiello, and S. Basri. [nd] 4p. (AECU-1366)

Report is made of a study of the selection rules in the reactions of slow π^- mesons with tritium, namely: (1) $\pi^- + H^3 \rightarrow 3n$, and (2) $\pi^- + H^3 \rightarrow 3n + \gamma$. For reaction (1), selection rules based on conservation of angular momentum and parity do not exist, but observations on the symmetry character of H^3 make it apparent that reaction (1) is very sensitive to the spin and parity of π^-, and some selection rules are thus derived. For reaction (2) there appears no evidence for any selection rules, whatever the spin and parity of the meson. Since reaction (1) is forbidden in the case of scalar and pseudovector mesons, whereas reaction (2) is allowed for all types of meson fields, it follows that the ratio of the yield of the nonradiative to that of the radiative absorption reaction (n/γ) is greater in the case of an odd meson than in the case of an even meson, and in particular: $(n/\gamma)_{ps} \gg (n/\gamma)_{pv}$.